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North Fork Coal
ENVIRONMENTAL IMPACT STATEMENT

Delta and Gunnison Counties, Colorado
September 1999

99-033838

Lead Agencies:

USDI Bureau of Land Management

USDA Forest Service

Cooperating Agency:

USDI Office of Surface Mining Reclamation & Enforcement

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NORTH FORK COAL
DRAFT
ENVIRONMENTAL IMPACT STATEMENT

U.S. Department of the Interior - Bureau of Land Management
Colorado State Office
Uncompahgre Field Office

U.S. Department of Agriculture - Forest Service
Rocky Mountain Region
Grand Mesa, Uncompahgre and Gunnison National Forests

Cooperating Agency:

U.S. Department of the Interior
Office of Surface Mining Reclamation and Enforcement
Western Regional Coordinating Center

September 1999

U.S. Department of the Interior
Bureau of Land Management
2465 S. Townsend Avenue
Montrose, Colorado 81401

U.S. Department of Agriculture
Forest Service
2250 Highway 50
Delta, Colorado 81416

NORTH FORK COAL
DRAFT ENVIRONMENTAL IMPACT STATEMENT
SEPTEMBER 3, 1999

Dear Ladies and Gentlemen:

Enclosed for your review is the North Fork Coal Draft Environmental Impact Statement (EIS). This document describes the existing environmental conditions and the potential effects associated with the leasing of the Iron Point and Elk Creek Coal Lease Tracts located in Delta and Gunnison counties, Colorado. The EIS also describes the environmental effects of granting a coal exploration license on an area within and surrounding the Iron Point Coal Lease Tract.

The U.S.D.I. Bureau of Land Management (BLM) and the U.S.D.A. Forest Service (Forest Service) are the joint lead agencies in the preparation of this EIS. The Office of Surface Mining Reclamation and Enforcement (OSM) is a cooperating agency on this EIS. We appreciate the comments, suggestions, and ideas received during scoping.

To aid in the preparation of the Draft EIS, we held a public scoping meeting on Wednesday, April 21, 1999 in Hotchkiss, Colorado. The healthy debate and many constructive comments generated before and during the EIS public scoping period greatly assisted the BLM and the Forest Service in identifying issues and preparing the environmental analysis in this Draft EIS. We want to thank you for your participation in this project and hope you find the analysis responsive to your concerns.

Some of the key issues for this project include: the potential effects of coal shipping from the North Fork Valley on the Union Pacific Railroad; the effects of increased coal truck traffic on State Highway 133; the potential effects to the integrity of watersheds and irrigation facilities within and surrounding the lease tracts, including the Terror Creek Ditch and the Terror Creek Reservoir; the effects to the local social and economic structure in Delta and Gunnison counties; and the cumulative effects that coal exploration and mining might have on the region.

Besides the No-Action Alternative (Alternative A) and the coal leasing as applied for by Bowie Resources Ltd. and Oxbow Mining Inc. (Alternative B), we examined two other alternatives in the completion of the Draft EIS. In these other alternatives, we analyzed the possibility of multi-seam mining and the restriction of subsidence due to underground mining in key sensitive areas.

This Draft EIS is not a decision document. Following public review and comment on the Draft EIS, the BLM and Forest Service will consider all comments in the preparation of a Final EIS. Following release of a Final EIS, the BLM and Forest Service will document their decisions on coal leasing and the exploration license in documents known as Records of Decisions. Your comments on this Draft EIS will help the BLM and the Forest Service make the best, most informed decisions possible.

Copies of the Draft EIS, and other relevant documents such as the scoping report are available for review at the following locations:

Bureau of Land Management
Uncompahgre Field Office
2465 S. Townsend Avenue
Montrose, Colorado 81401

Forest Service
Paonia Ranger District Office
North Rio Grande Avenue
Paonia, Colorado 81428

Bureau of Land Management
Colorado State Office
2850 Youngfield Street
Lakewood, Colorado 80215

Office of Surface Mining
1999 Broadway, Suite 3410
Denver, Colorado 80202

Forest Service
Supervisor's Office
2250 Highway 50
Delta, Colorado 81416

Copies of the Draft EIS have also been placed in the local libraries in Paonia, Hotchkiss, Delta, Montrose, and Grand Junction.

With the release of the Draft EIS, we again invite your comments, suggestions, and ideas regarding the proposed projects. We will take comments on the Draft EIS for 60 days. Comments must be post marked by November 3, 1999. Please include your name, address, telephone number, organization, title of project on which you are commenting, and specific facts and supporting reasons for the decision makers to consider. In addition to comments received on the Draft EIS, the BLM will also consider comments on the issues of fair market value and maximum economic recovery of the coal tracts. Please address written comments to the Bureau of Land Management , Uncompahgre Field Office, 2465 S. Townsend Avenue, Montrose, Colorado 81401, Attention Jerry Jones. Written comments may also be faxed to (970) 240-5368.

Comments on the Draft EIS, including names and street addresses of respondents, will be available for public review at the BLM and Forest Service offices in Montrose and Delta respectively, during regular business hours (9:00 a.m. - 4:30 p.m., Monday through Friday, except holidays), and may be published as part of the Final EIS. Individual respondents may request confidentiality. If you wish to withhold your name or street address from public review or from disclosure under the Freedom of Information Act, you must state this prominently at the beginning of your written comment. Such requests will be honored to the extent allowed by law. All submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be made available for public inspection in their entirety.

During the review period, the BLM and the Forest Service will host two meetings. The coal leasing process requires the BLM to hold a formal public hearing where testimony can be presented by the public addressing environmental considerations and the fair market value and maximum economic recovery of the coal resource. In an effort to facilitate the public's review and comment, a more informal public meeting will be held one week earlier. This meeting will be held in an open house format and is intended to help the public understand the organization and content of the technical analysis. The informal public meeting will be held October 7, 1999 and the formal hearing will be held October 14, 1999. Both meetings will be held at the Hotchkiss High School and will begin at 7:00 p.m.

Please retain this Draft EIS for future reference. If the Final EIS for this action is published in an abbreviated format, you will need both documents to assess the impacts, both positive and negative, of the proposed alternatives. Further information on the North Fork Coal Draft EIS can be obtained by contacting Mr. Jerry Jones at the BLM Uncompahgre Field Office, 2465 S. Townsend Avenue, Montrose, Colorado 81401, telephone (970) 240-5338, fax (970) 240-5368, or e-mail Jerry_Jones@co.blm.gov.

Respectfully submitted,

Allan Belt
Field Office Manager
BLM Uncompahgre Field Office

Robert Storch
Forest Supervisor
Grand Mesa, Uncompahgre and Gunnison National Forests

NORTH FORK COAL
DRAFT ENVIRONMENTAL IMPACT STATEMENT
AUGUST 1999

Lead Agencies: Bureau of Land Management
Forest Service

Cooperating Agency: Office of Surface Mining Reclamation and Enforcement

Responsible Officials:

Ms. Ann Morgan, State Director Bureau of Land Management 2850 Youngfield Street Lakewood, Colorado 80215	Mr. Robert Storch, Forest Supervisor Grand Mesa, Uncompahgre and Gunnison National Forests 2250 Highway 50 Delta, Colorado 81416

For Further Information: Mr. Jerry Jones, EIS Coordinator
Bureau of Land Management
2465 S. Townsend Avenue
Montrose, Colorado 81401

Abstract: The North Fork Coal Draft Environmental Impact Statement (EIS) describes the physical, biological, social, and economic resources that would be potentially affected by leasing of the Iron Point and Elk Creek Coal Lease Tracts as well as an exploration license area within and surrounding the Iron Point Coal Lease Tract. The federal decisions to be made involve the approval or disapproval of coal leasing (the Iron Point and Elk Creek Tracts), and of an exploration license. Some of the key issues for these proposed actions include: the potential effects of transporting over 19 million tons of coal per year from the North Fork Valley on the Union Pacific Railroad, the effects of increased highway traffic on State Highway 133; the potential effects to the integrity of watersheds and irrigation facilities within and surrounding the lease tracts, including the Terror Creek Ditch and the Terror Creek Reservoir; the effects to the local social and economic structure of Delta and Gunnison Counties, and the cumulative effects that coal exploration and mining might have on the region.

Comment Period: The comment period on the Draft EIS will be 60 days from the date the EPA publishes the Notice of Availability in the Federal Register and public notice is given in newspapers of local circulation. **Comments to the North Fork Coal Draft EIS should be sent to the BLM, 2465 S. Townsend Avenue, Montrose, Colorado 81401, Attention Jerry Jones, and should be post marked no later than November 3, 1999.**

Important Notice: Reviewers should provide the BLM and the Forest Service with their comments during the review period of the Draft EIS. This will enable the BLM and the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the Final EIS. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewer's position and contentions, (Vermont Yankee Nuclear Power Corp. vs. NRDC 435 US 519 553 1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the Final EIS (City of Angoon vs. Hodel 9th Circuit 1966) and (Wisconsin Heritage, Inc. vs. Harris, 490f. Supp. 1334, 1338 e.d. Wis. 1980). Comments on the Draft EIS should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1403.3).

Summary

SUMMARY

S-1.0 INTRODUCTION

The Bureau of Land Management (BLM) Colorado State Office and the USDA Forest Service (Forest Service) Grand Mesa, Uncompahgre, and Gunnison National Forests (GMUG) are joint lead agencies considering two lease-by-applications (LBA) for federal coal and a coal exploration license in the North Fork of the Gunnison River Valley. The west lease tract is known as the Iron Point Tract, and BLM has assigned this tract serial number COC-61209. This tract covers approximately 3,403 acres of federal coal in Delta County, Colorado. The LBA tract to the east is known as the Elk Creek Tract; the BLM has assigned this tract serial number COC-61357. This tract covers approximately 3,703 acres of federal coal in both Delta and Gunnison counties, Colorado. The coal exploration license application is on unleased lands within and adjacent to the Iron Point Coal Lease Tract; the BLM has assigned this exploration license area serial number COC-61945. The exploration license area contains approximately 6,053 acres.

In January of 1999, as part of the National Environmental Policy Act (NEPA) public process, the BLM and the Forest Service determined that the requirements of NEPA would be best served by preparing a consolidated EIS for the two coal lease tracts and the exploration license area.

As required by NEPA, a scoping process was initiated in March 1999 to solicit comments from the general public, businesses, special interest groups, and government agencies regarding the coal leasing and an exploration license. On April 13, 1999, a Notice of Intent to prepare an EIS was published in the Federal Register by the BLM and the Forest Service. A public scoping meeting was held in Hotchkiss, Colorado on Wednesday night, April 21, 1999. The formal scoping period ended on May 17, 1999.

S-1.1 Proposed Action

There are three proposed actions associated with this EIS:

- Lease the Iron Point Coal Lease Tract on federal lands in Delta County, Colorado, for underground coal mining;
- Lease the Elk Creek Coal Lease Tract on federal lands in Delta and Gunnison, counties, Colorado, for underground coal mining; and,
- Issue an exploration license for coal exploration on federal lands in Delta County, Colorado.

S-1.2 Purpose and Need

With the preparation of the North Fork Coal EIS, the BLM and Forest Service are responding to coal lease tract applications submitted by Bowie Resources Ltd. (Bowie) and Oxbow Mining Inc. (Oxbow), as well as an exploration license application submitted by Bowie under authority of 43 CFR 3400. The purpose and objective for Bowie and Oxbow with regard to the Iron Point and Elk Creek Coal Lease Tracts, respectively, are to continue their existing coal mining operations.

Bowie requested the Iron Point Coal Lease Tract in order to maintain reserves to supply potential customers and to economically justify the installation of a longwall mining system. The federally owned coal deposits in the Iron Point Coal Lease Tract are a logical extension to the existing operations at the Bowie No. 2 Mine.

Bowie also filed for the exploration license in order to obtain additional information regarding coal resources in the Iron Point Coal Lease Tract and areas to the north of the tract. Such exploration is required to further delineate the extent of the coal resources in this area, as well as to obtain coal quality information on the coal. Ark Land Company (an affiliate of Mountain Coal Company) elected to participate in this exploration program with Bowie.

Oxbow applied for the Elk Creek Coal Lease Tract as a logical extension to its existing mining. Oxbow presently operates with a longwall system for underground mining at its Sanborn Creek Mine.

Both the BLM and the Forest Service maintain policies which allow private industry to explore, develop, and mine coal on federal lands. Pursuant to the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1976, the BLM administers a coal leasing program to allow the private sector to mine federally owned coal reserves. Under the terms of this law, the BLM is charged with the administration of the coal mineral estate on federal lands and is required to lease coal for economic recovery. Consent by the surface management agency (the Forest Service in this case) is required before BLM can proceed with leasing.

S-1.3 Decisions to be Made

The BLM and the Forest Service are the joint lead agencies responsible for completion of this EIS. The Office of Surface Mining Reclamation and Enforcement (OSM) is a cooperating agency on this EIS. These three agencies are following specific procedures that began with scoping and data collection and continued with analysis of data and evaluation of alternatives. In accordance with regulations implementing NEPA (40 CFR 1500), the results of this analysis are documented in the EIS and will form the basis for decisions to be made on the Iron Point and Elk Creek Coal Lease Tracts, as well as the Iron Point Exploration License application.

After the close of the Draft EIS review and comment period, the BLM and Forest Service will consider comments submitted and will respond to those comments in a Final EIS. OSM will assist the BLM and Forest Service with comments pertinent to areas of their jurisdiction and expertise. The BLM and Forest Service will consider and respond to these comments by:

- Modifying alternatives;
- Developing new alternatives;
- Modifying the analysis;
- Making corrections; and/or,
- Explaining why comments do not warrant further agency response.

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After the release of a Final EIS, the BLM and Forest Service will issue Records of Decision regarding their respective decisions on the leasing applications and exploration license. In Records of Decision, the BLM and Forest Service may decide to:

- Adopt the No-Action Alternative (no leasing and/or exploration license);
- Adopt the Proposed Actions (lease the coal as applied for by the applicants and/or grant the exploration license);
- Adopt an alternative with features of several of the alternatives; or,
- Adopt one of the action alternatives with additional mitigation measures.

The BLM Colorado State Director is the NEPA responsible signatory official for the BLM. The Forest Supervisor of the GMUG is the NEPA responsible official for the Forest Service.

If approved, the leases would be offered by competitive bid. If one or both of the coal leases are issued, no mining or surface development could occur on the tracts until the lessee or operator submits, and receives approval of a permit application package (PAP) under the Surface Mining Control and Reclamation Act. A PAP must be submitted to both the OSM and the Colorado Division of Minerals and Geology (DMG) for any proposed coal mining and reclamation operations on lands within Colorado.

S-1.4 Issues and Concerns

Scoping was conducted to focus the EIS on those issues and concerns considered important to the public and various government agencies. A Scoping Summary Document was prepared and made publically available in July 1999.

The issues that are addressed in the North Fork Coal Draft EIS are as follows:

- **Air Quality:** Identify and minimize air quality impacts;
- **Aquatic Resources/Fisheries:** Minimize disturbance to fish habitat and fish populations;
- **Cultural Resources:** Identify cultural resources and minimize disturbance impacts to these resources;
- **Cumulative Impacts:** Address the cumulative impacts of leasing and exploration with other potential projects;
- **Geology/Geotechnical Issues/Subsidence:** Identify geologic hazards on the lease sites and the potential for subsidence by underground mining activities;
- **Health/Safety:** Protect worker health and safety;
- **Land Use:** Minimize disturbance;
- **Noise:** Identify and minimize noise impacts;
- **Reclamation:** Provide for reclamation of disturbed areas;

- **Recreation:** Minimize disturbance to recreational opportunities;

- **Socioeconomics:** Address the social and economic impacts on local residents of Delta and Gunnison counties;

- **Surface Water/Groundwater:** Identify and minimize impacts to water quality and hydrology to maintain the integrity of watersheds within and surrounding the lease tract areas. Maintain adequate flows to drainages and ditches above underground mining activity;

- **Transportation:** Address truck and train traffic impacts created by coal mining in the North Fork of the Gunnison Valley and the potential for accidents;

- **Vegetation:** Address the impacts to vegetation as a result of mining and exploration activity;

- **Wetlands:** Identify and minimize impacts to wetlands/riparian areas; and,

- **Wildlife:** Minimize disruption to terrestrial wildlife and wildlife habitats.

S-2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The discussion of alternatives is the foundation of the EIS process. The BLM and Forest Service have explored and evaluated numerous ideas and options during the selection and development of the alternatives which includes a No-Action Alternative and several Action Alternatives including the plans as submitted by the applicants for the exploration license and the coal lease tracts. In total, four alternatives (including the No-Action Alternative) were developed for evaluation in the EIS.

Alternatives were developed and analyzed to respond to the purpose for and need of the proposed actions, to address social and environmental issues, to respond to public and agency concerns and input, and to satisfy NEPA regulations.

Under the action alternatives considered, the BLM would hold coal lease sales for the Iron Point and Elk Creek Coal Lease Tracts, subject to coal lease stipulations of the BLM and the Forest Service, as well as any coal lease stipulations developed as part of the EIS process. It should be noted that the LBA process is, by law, an open, public, competitive, sealed-bid process whereupon the coal lease would be granted to the highest qualified bidder.

S-2.1 Alternative A - No-Action

This alternative assumes no leasing would occur and that the exploration license would be denied. This alternative presents the existing conditions in the North Fork of the Gunnison Valley and would represent a baseline for impact analysis. NEPA requires that a "No-Action" alternative be considered in environmental documents. Under the No-Action Alternative, Bowie and Oxbow could continue their coal operations under existing regulatory approvals.

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S-2.2 Alternative B - Proposed Action

This alternative was generated based on the original coal lease applications submitted by Bowie and Oxbow.

The proposed action for the Iron Point Coal Lease Tract assumes a northern boundary south of the Terror Creek Reservoir, along with an area that would provide access under Terror Creek to coal reserves to existing federal coal lease (C-37210) in an area known as the Bowie No. 1 "pod." There would be no subsidence under the Curecanti-Rifle 23/345 kV electric transmission line which essentially is parallel to Terror Creek. Production from the Iron Point Coal Lease Tract was assumed to be 5 million tons per year from the D coal seam via longwall mining techniques.

The Elk Creek Coal Lease Tract would also be mined by longwall techniques. The production on this tract would range from 4 to 6 million tons per year.

Alternative B would also involve issuing the exploration license according to the potential development scenario as submitted by the applicants.

S-2.3 Alternative C - Multiple Seam Mining

This alternative is similar to Alternative B, with the inclusion of additional B seam coal reserves in the Iron Point Coal Lease Tract, as well as additional surface area and reserves that are located between the Iron Point and Elk Creek Coal Lease Tracts. An area was also added to the Iron Point Coal Lease Tract in the Terror Creek drainage to facilitate flexibility in locating entries beneath Terror Creek for access to coal in the Bowie No. 1 "pod." In Alternative C, mining would be completed by longwall techniques, and coal production would be the same as outlined in Alternative B.

S-2.4 Alternative D - Subsidence Protection

This alternative would be the same as Alternative C, with the limitation that there would be no subsidence under Terror or Hubbard creeks, or the Curecanti-Rifle 230/345 kV electric transmission line.

S-2.5 Preferred Alternative

The responsible agencies have identified a preferred alternative that is best described as a combination of Alternatives B and D. Both Alternatives B and D provide for leasing with standard special coal lease stipulations, but differ in whether the subsidence would be allowed under perennial drainages and whether additional seams and acreage would be included. The agencies have decided that protection of perennial drainages would be necessary to maintain watershed integrity and ecosystem health. Provisions in Alternative D offer protection for perennial drainages by eliminating subsidence in those areas. Coal recovery would range from 45 million tons identified for Alternative B to 66 million tons identified for Alternative D.

For the Iron Point Coal Exploration License, the preferred Alternative is B. Alternative B for the exploration license would provide standard and special surface use stipulations to reduce potential surface impacts.

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S-3.0 ENVIRONMENTAL ANALYSIS

This section of the EIS describes both the existing conditions of and the environmental consequences to the area and its resources. Resource descriptions focus on areas which would likely be affected by reasonably foreseeable mining and exploration activities.

S-3.1 Air Quality/Climate

Existing Conditions - The air quality and climate in the North Fork of the Gunnison River Valley are influenced by the rugged topography and the prevailing east-southeast winds. The air quality of the region is good.

The mountain valleys on the west side of the Rockies are subject to large ranges in precipitation and temperature conditions. The monthly temperature profiles at Paonia, Colorado show a range from an average daily of 24.9° F in January to an average monthly value of 72.6° F in July. Precipitation ranges from 0.08 inches in June to 1.61 inches in October, with an average annual precipitation at Paonia of 15.17 inches. The prevailing wind direction in the North Fork of the Gunnison River Valley near the community of Somerset is east-southeast. The daily cycle of changing up-valley and down-valley local wind directions is common is western Colorado mountain areas. The strongest winds, presumably associated with passing thunder storms and pre-frontal weather are from the south or southwest.

Environmental Consequences - Due to anticipated increased coal production from the coal mines in the North Fork of the Gunnison River area, emissions from mining operations in the North Fork Valley and coal trains are expected to increase for the No-Action and Action Alternatives; however, any increase in the local emissions of particulate matter and tailpipe exhaust is not expected to cause any impacts to the existing ambient air quality of the region. In addition, any incremental increases in particulate emissions and gaseous emissions resulting from the action alternatives should not cause any observable, detectable or measurable visibility impacts at the West Elk Wilderness Area or at the Black Canyon of the Gunnison National Monument.

S-3.2 Topography/Physiography

Existing Conditions: The topography of the area within and immediately surrounding the exploration license area and the coal lease tracts ranges from steep to relatively flat. Elevations range from slightly over 5,600 feet in the North Fork of the Gunnison River Valley near the town of Paonia to elevations over 10,000 feet in the mountains surrounding the exploration license and lease tract areas. The topography of the area has been influenced by a wide range of mass-movement land forms and processes at work in the region, including localized natural landslides and rock falls.

Environmental Consequences: Exploration activities as proposed for the Iron Point Exploration License Area would have no noticeable topographic impact.

If the tracts are leased, subsequent underground longwall mining would cause subsidence and physically lower the surface over mined areas. Effects of subsidence would be most noticeable on ridges and steeper slopes, particularly cliffs, where cracks might open on the order of few inches to possibly 1-foot wide and 25 to 50 feet deep. Fewer cracks would occur in the valleys than on ridges, because the valleys are more stable and the alluvial material found in the valleys tends to be more yieldable than some of the brittle bedrock found on the ridges. Subsidence from longwall mining could aggravate the movement of existing landslides and rock falls in areas of moderate to high subsidence potential.

S-3.3 Geology

Existing Conditions: The exploration license area and the coal lease tracts lie in the Paonia-Somerset coal field which contains medium to high coal development potential deposits. The main coal beds within this area are found in the Upper Cretaceous Mesa Verde Formation, which is overlain by the Tertiary Wasatch Formation and underlain by the Upper Cretaceous Mancos Shale. In addition to the sedimentary units in the region, isolated igneous intrusions have been encountered. The coal bearing sedimentary strata of the Mesa Verde Formation are relatively flat lying with a regional dip of approximately 5 degrees to the north/northeast. The principal mineable coal seams on the Iron Point Coal Lease Tract are the "D" seam and the "B" seam. The primary mineable coal seam on the Elk Creek Coal Lease Tract is the "D" seam. The overburden overlying the D coal seam in both lease tracts is generally greater than 500 feet and reaches over 2,000 feet in parts of both lease tracts.

Environmental Consequences: There would be negligible effect to the geological resources as a result of drilling activities in the Iron Point Exploration License Area.

If leasing and mining proceeds on the Iron Point and Elk Creek Coal Lease Tracts, coal would be removed by longwall mining techniques, and the overlying overburden material would be altered through subsidence. Subsidence would cause a gradual lowering of the surface after the longwall shearer removes the coal. Some cracking would be evident as the shearer passes, and cracking would be also evident along the fringes of the extracted longwall panels. Due to the thickness of the overburden in the two lease tracts, subsidence would not be easily evidenced by casual observers. The historic (pre-mining) burning of the coal along the outcrop (causing the reddish coloration in the strata in the valley) would preclude a significant amount of mining close to the outcrop; therefore, rock falls induced by subsidence would be unlikely. There is a potential that mining subsidence could aggravate existing landslides in the Hubbard Creek drainage.

Areas under 500 feet of overburden cover to the coal seam would show "high to very high" subsidence potential. The potential subsidence impacts are lessened with the depth of overburden. Potential subsidence impacts of "low to very low" are typically those areas greater than 1,500 feet of overburden depth to the coal seam.

S-3.4 Soils

Existing Conditions: A total of 32 soil map units, characterized by 38 soil series, families, or miscellaneous groupings, were delineated within and surrounding the lease tracts and exploration license area. These soils are forming in response to a wide variety of parent materials, elevations, slopes, aspects, and rates of material weathering common to the region as a whole.

Environmental Consequences: If exploration occurs, and if leasing and subsequent mining activities occur, approximately 33.5 acres of surface disturbance could occur by the construction of various boreholes, shafts, light-use access roads, and drill pads. Impacts to soils include the salvage and stockpiling of selected soils for later re-application, along with potential compaction and erosion. Given the size and form of the individual facilities comprising the proposed disturbed acreage, as well as regulatory requirements for revegetation, any impacts to soils would be limited and considered to be short-term and mitigable. The disturbance of 33.5 acres represents an increase of approximately 10 percent over the acreage of soils disturbed by coal operations in the project area to date, and would amount to less than 1 percent of the acreages included in the lease tracts and exploration area as a whole.

S-3.5 Surface Water

Existing Conditions: The North Fork of the Gunnison River is located south of the coal lease tracts and exploration license area. Hubbard Creek and Terror Creek drain the Iron Point Exploration License Area and the Iron Point Coal Lease Tract. Hubbard Creek, Bear Creek, and a small portion of Elk Creek drain the Elk Creek Coal Lease Tract. Hubbard, Terror, Bear and Elk creeks are tributaries to the North Fork of the Gunnison River. Hubbard and Terror creeks are perennial drainages in the area. Bear and Elk creeks are ephemeral drainages, flowing only in response to snow melt or severe thunder storms. The surface water quality of Hubbard and Terror creeks and the North Fork of the Gunnison River is calcium bicarbonate type water.

Stream flow in the North Fork of the Gunnison River has been monitored at a US Geological Survey station near the community of Somerset since 1933. The drainage area at the Somerset station is 526 square miles. The highest annual mean flow at this station during the period of record was 829 cubic feet per second (cfs) in 1984. The highest instantaneous peak flow of 9,220 cfs was recorded on May 24, 1984. The lowest annual mean flow for the same station and period of record was 114 cfs in 1997.

Various National Pollutant Discharge Elimination System (NPDES) permits granted to mine operators in the North Fork Valley regulate impacts of current and historic mining on local streams. Monitoring on the North Fork of the Gunnison River shows little impact to the water quality from current or historic mining. Occasional increased concentrations of metals have been observed during periods of increased runoff during the spring. Somewhat elevated sulfate concentrations have been noted in gulches down-drainage of historic mining operations, but these concentrations do not impact the water quality of the North Fork of the Gunnison River.

Environmental Consequences: Potential environmental consequences of leasing (and subsequent mining of) the Iron Point and Elk Creek Coal Lease Tracts and granting the Iron Point Exploration License include the following impacts:

- Dewatering of the D coal seam could flow on some sections of Hubbard Creek, which are fed from the D seam;
- Water discharge from mine to surface streams could impact the quality of water in the receiving streams; but mines must comply with terms and conditions of National Pollutant Discharge Elimination System (NPDES) permits, so quality impacts should be minimal.

- Subsidence caused by longwall mining could potentially disrupt stream flows and ponds directly above the underground mining and within the angle of draw. Other impacts could include changes in drainage channel morphology resulting in changes in general surface gradients, which could lead to head cutting, pooling, soil erosion, and sedimentation; and,

- Exploration, construction activities, and use of surface facilities could increase sedimentation; but any exploration and mining activities must comply with the erosion and sediment control standards of the BLM, Forest Service, OSM, and Colorado Division of Minerals and Geology, so sedimentation impacts should be minimal.

S-3.6 Groundwater

Existing Conditions: The principal groundwater-bearing zones in the North Fork of the Gunnison River Basin occur in Quaternary alluvial and colluvial deposits. Some water also occurs in Cretaceous bedrock.

Alluvial deposits along the North Fork of the Gunnison River represent a major aquifer. The municipal water supply for the town of Paonia is derived from groundwater wells developed in the alluvium along the North Fork of the Gunnison River. The water quality of alluvium groundwater is calcium bicarbonate type and good quality. The total dissolved solids (TDS) concentrations of the groundwater range from 43 to 2,300 mg/l with concentrations of sulfate, TDS, and manganese sometimes exceeding federal drinking water standards. Well yields from this zone range from 1 to 150 gpm and average about 20 gpm.

Colluvial water-bearing units located on valley slopes are generally isolated and are limited in extent. These units are normally saturated seasonally and have a low storage capacity and yield. Most springs and seeps in the region issue from colluvial deposits underlain by less permeable bedrock. Seasonal spring discharge from colluvial deposits range from about 0.2 up to 20 gpm, and average about 5 gpm. Colluvial deposits do not represent an aquifer in the region, and no reported wells are developed in this zone; however, numerous seasonal springs and seeps issue from these zones and have been developed for livestock watering and also support wildlife.

The primary bedrock water-bearing zones in the North Fork of the Gunnison River Basin are in the sandstone and conglomerate units and fractured zones of the Lower Cretaceous Burro Canyon Formation and the Late Cretaceous Dakota Sandstone. Minor groundwater occurrence is reported in the Late Cretaceous Mancos Shale, Mesa Verde Formation, and Tertiary Wasatch Formation. Well yields from these formations range from about 0.5 to 25 gpm, with a typical average of approximately 10 gpm. Water quality from bedrock wells is generally sodium bicarbonate/sulfate type with TDS concentrations ranging from 490 to 8,200 mg/l, averaging about 2,569 mg/l. Concentrations of sulfate, TDS, manganese, and fluoride typically exceed federal drinking water guidelines.

Past and current mining activities have affected groundwater quantity and quality in the region. For example, mine discharge from the abandoned Oliver Mine and the abandoned Hawk's Nest Mine is fair but with somewhat elevated levels of TDS, iron, and manganese. Past and current activities other than mining have also affected groundwater quality. Livestock grazing causes

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minor impacts to springs and seeps due to erosion, sedimentation, and water quality (i.e., fecal coliform). Unauthorized off-road vehicle use also causes erosion and sedimentation that affect spring and seep areas. Rural septic systems may impact local groundwater quality.

Environmental Consequences: Exploration activities should not noticeably impact groundwater resources. The strata are not uniformly saturated, so there is little concern for inter-strata communication. The drill holes would be small diameter, and have little disturbance to the strata.

Longwall mining of the lease tracts would cause bedrock fracturing and land subsidence above longwall panels. By potentially providing pathways for groundwater to move downward toward the mine horizon, fracturing and subsidence may divert water from saturated horizons and surface water bodies above and adjacent to caved areas. Impacts to groundwater systems may result in the decrease in natural discharge rates from springs and seeps or changes in water levels and yields in area wells.

Mining would dewater the coal horizon and water saturated horizons immediately above and below the coal horizon. Degradation of water quality could occur when groundwater flows through active or abandoned mine workings. Diversion of groundwater resulting from dewatering of the coal seam could also occur as a result of underground mining. Water rights could be affected if area spring flows and associated pond levels and well water levels are diminished. There is also a potential for increased sedimentation to area springs from construction and use of surface facilities (exploration drill pads and associated access roads).

After mining, mine voids could fill with groundwater. The groundwater would be exposed to collapsed and abandoned mine workings, and the quality of the water may be impacted. The most likely impact would be an increased concentration of TDS, iron, manganese, and possibly sulfate. The groundwater flow direction in the coal seams of the lease tracts is to the northeast, beneath the Grand Mesa. There are no known wells or springs down gradient of the lease tracts that could be affected by any possible groundwater degradation.

S-3.7 Vegetation

Existing Conditions: Eight upland vegetation types were mapped at the reconnaissance level within and surrounding the coal lease tracts and exploration license area. These vegetation types include the following communities:

- Oak
- Aspen
- Pinon/Juniper
- Douglas fir
- Cottonwood
- Spruce/fir
- Grass/forb
- Bare

A number of noxious weed species are known to be of concern in Delta and Gunnison counties. These species include Russian knapweed, hoary cress, yellow toadflax, Canada thistle, musk thistle, and scotch thistle.

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No federally listed threatened or endangered plant species are known to exist on either coal lease tract or the exploration license area. A "forest-sensitive" species, Hapman's coolwort, could be present at the Hubbard Falls area.

Environmental Consequences: The construction of various borehole, shaft, and access road facilities would directly affect a maximum of approximately 33.5 acres of vegetation. The primary vegetation communities to be affected include oak and aspen vegetation types. The resulting loss of any timber or grazing resources would be minimal, with the potential for a slight long-term increase in grazing potential possible following revegetation activities. It is unlikely that any measurable impact to vegetation would occur as a result of mine subsidence.

S-3.8 Wetlands

Existing Conditions: No formal delineations of wetlands or other Waters of the U.S. were completed on either the coal lease tracts or the exploration license area. Seep and spring information was compiled for the coal lease tracts and the exploration area.

Wetland and riparian plant communities, other than those associated with seeps, springs, and stockponds, are typically confined to the borders of creeks and drainage channels. Wetland hydrology is provided primarily by channel flooding and lateral flow. Wetland/upland transition zones are typically narrow to abrupt as a function of channel topography. Wetland vegetation communities are comparatively simplistic in terms of diversity, typically being dominated by a few hydric species. The tree stratum, where it occurs, is dominated by narrow-leaf cottonwood and boxelder at lower elevations. Aspen is the common tree of wetlands occurring at higher elevations. Dominant wetland shrubs include a variety of willows such as coyote willow and diamond willow, thinleaf alder, and red-osier dogwood.

Springs and seeps in the region typically support willows along with a variety of grasses and forbs. Springs and seeps on nearly level to moderate terrain, particularly at higher elevations, support herbaceous communities with species as California false-hellebore, streamside bluebells, and various sedge species. Stockponds are man-made features which are filled either by spring or overland runoff. Wetlands occurring in association with developed stockponds are typically limited to a narrow bank fringe, dominated primarily by spikerush and rush species. Other species such as small-winged sedge, clustered field sedge, northwest cinquefoil, and a variety of butter-cups may also be present.

Environmental Consequences: Impacts, which would vary by action alternative, are directly associated with potential subsidence and possible dewatering in Hubbard and Terror creeks.

With dewatering of the D coal seam during operations, some wetlands along Hubbard Creek could be affected. Depending upon the size of the reduction, the wetland/riparian area boundary zones might shrink along the margins of Hubbard Creek. Dominant wetland herbaceous species inhabiting this zone and requiring saturated soils throughout the growing season would likely be replaced, in part, by wetland or upland plants adapted to less hydric soil moisture regimes. Following cessation of underground mining activities, the abandoned workings would fill with water and be expected to recover to approximate conditions that existed prior to mining. When this occurs, spring and seep conditions would be expected to return to Hubbard Creek near the vicinity of the D coal seam subcrop. With the return of seep and spring flows, the wetlands of Hubbard Creek near the D coal seam subcrop would essentially

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revert to their pre-mining condition in terms of extent and overall function, diversity, and productivity.

S-3.9 Terrestrial Wildlife

Existing Conditions: The lease tract and exploration license areas occur within Colorado Division of Wildlife Game Management Unit 521. Mule deer, elk, black bear, and mountain lion occur within this area. Mule deer and elk populations within the area exhibit seasonal movements to and from higher to lower elevation habitats in response to weather patterns and snow cover.

Habitat for water birds is restricted primarily to the North Fork of the Gunnison River, although there is some water bird habitat associated with Hubbard Creek, Terror Creek, and Terror Creek Reservoir. Use of the area for resting, feeding, or nesting by water birds is limited to puddle ducks (such as mallard and teal), spotted sandpiper, and killdeer.

Several species of raptors are known to occur and nest within the region. These include turkey vulture, northern harrier, golden eagle, Cooper's hawk, sharp-skinned hawk, red-tailed hawk, prairie falcon, American kestrel, western screech owl, great horned owl, northern pigmy owl, long-eared owl, and northern saw-whet owl. Nest site preferences of raptors vary considerably, ranging from relatively large trees with open crowns or on cliff ledges and areas of rock outcrop. Nesting by a pair of golden eagles has been documented by the Forest Service in upper Hubbard Creek Canyon.

A variety of song bird and similar species reside within the region. The majority of these species migrate south or to lower elevations for wintering months, and only a few species remain in the region during winter months. Woodpeckers, jays, chickadees, nuthatches, and finches are representative year-round residents.

No identified critical habitat for any state or federally listed threatened or endangered species has been identified within or immediately surrounding the coal lease tracts or exploration license area. The bald eagle is present as a winter resident along the North Fork of the Gunnison River drainage. This drainage and adjacent habitats are designated as a winter concentration area and winter range for bald eagles, by the Colorado Division of Wildlife. There is also potential for tiger salamander and boreal toad to exist in wetland and riparian habitats, particularly along Hubbard Creek.

Environmental Consequences: The construction of various borehole, shaft, and access road facilities would create approximately 33.5 acres of new surface disturbance in currently undisturbed areas of vegetation communities and wildlife habitats. The principal wildlife habitats to be affected would be oak and aspen habitats. Potential affects to species of concern are greatest with loss of aspen, Douglas fir, and cottonwood habitats, but most of these impacts can be avoided with the implementation of appropriate mitigation measures.

Impacts to wetlands and riparian habitat, as well as to potential breeding habitat for boreal toad and tiger salamander, would occur if there was construction of a drill site access road along Hubbard Creek. However, there is a Forest Service stipulation that precludes road and pad construction in riparian areas or wetlands.

Other impacts to terrestrial wildlife might include the surface effects of subsidence (mainly the creation of surface cracks), a potential increase in train and vehicle collisions with wintering mule deer and elk, and potential changes in bald eagle winter habitat resulting from any flow reductions in the North Fork of the Gunnison River.

S-3.10 Aquatic Resources/Fisheries

Existing Conditions: The main section of the North Fork of the Gunnison River is classified as a Class I cold water aquatic life by the Colorado Department of Public Health and Environment. This classification is defined as "...waters that (1) currently are capable of sustaining a wide variety of cold water biota, including sensitive species, or (2) could sustain such biota but for correctable water quality conditions."

Game fish species present in the river include rainbow trout, brown trout, cutthroat trout, and brook trout. Rainbow, brown, and cutthroat trout were stocked in the river from 1973 through 1995. Other game fish species such as northern pike and green sunfish sporadically occur in low numbers in the river; these species likely originate from Paonia Reservoir.

Hubbard and Terror creeks support limited trout populations. Trout and native fish species also occur seasonally in the Terror Creek Reservoir and in irrigation ditches; however, drawdown in the Terror Creek Reservoir in the summer restricts year-round habitat for fish. Elk and Bear creeks do not contain game fish species.

Four federally endangered fish species occur in river segments located downstream of the coal lease tracts. These include the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. The Colorado pikeminnow and razorback sucker presently occur in the Gunnison River. The occurrence of humpback chub is limited to one known recent record in the Gunnison River (1993). No bonytail have been collected in the Gunnison River; this species occurs in the Colorado River and is considered to be the rarest of the four Colorado federally endangered fish species.

Environmental Consequences: Short-term, local increases in turbidity and suspended sediments could occur during exploration activities adjacent to Hubbard Creek and Terror Creek if access roads are constructed. These short-term increases in sediment yield could result in short-term affects on aquatic species and their habitat. Sediment concentrations would stabilize and return to typical background concentrations after exploration activities are completed. By implementing proper drainage and detention structures, the impact of increased sediment levels on aquatic species and their habitat would be low. Any localized increases in sediment would not affect downstream areas in the Gunnison and Colorado rivers that are inhabited by the four federally endangered fish species.

The use of water for mining activities, dust control, and domestic purposes would result in a relatively small depletion of water from Terror Creek, Hubbard Creek, and the North Fork of the Gunnison River. The estimated withdrawal of water would result in total reductions of less than 1 cfs. This depletion would represent a relatively small reduction in habitat for aquatic species. This depletion would be negligible to sections of the Gunnison and Colorado rivers that are inhabited by the four federally endangered fish species.

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Mining operations on both coal leases could result in increased discharges to the North Fork of the Gunnison River. However, since all discharges must meet federal and Colorado Department of Public Health and Environment regulations, no adverse affects on aquatic species are anticipated due to the quality of discharged water.

The use and transport of fuels to the exploration sites and mining operations would represent a risk to aquatic species and their habitat, if a spill or accident occurred. By implementing a mitigation measure that would restrict any fueling of vehicles or equipment near streams, water bodies and their associated biological communities would be protected. The risk of a fuel spill or leak reaching the North Fork of the Gunnison River, Hubbard Creek, or Terror Creek during transport is considered extremely low, based on the expected low frequency of such traffic.

S-3.11 Cultural Resources

Existing Conditions: Cultural resource surveys within and surrounding the coal lease tracts and exploration license area revealed 15 sites. Most of these sites are located near the extreme western periphery of the area, generally along the east side of the Terror Creek drainage. This distribution apparently reflects previous survey activity in this area, and is not necessarily indicative of a similar cultural resource distributional pattern within the unsurveyed portions of the area. The sites previously recorded consist of eight isolated prehistoric lithic artifacts, three prehistoric open camp sites, two historic corrals, one historic dugout, and one historic dump site.

Historic mining has occurred within and adjacent to the coal lease tracts and exploration license area. The historic King Mine site and the associated Bowie town site, have extensive histories dating from the turn of the century era. Both the King Mine and the Bowie town site have been officially determined eligible for the National Register of Historic Places, but both of these sites are outside of the coal lease tracts and exploration license area.

Environmental Consequences: Cultural site density is low, and no impacts to cultural resources are anticipated. Subsidence as a result of longwall mining would not cause any discernable impacts to cultural resources on the site.

S-3.12 Noise

Existing Conditions: Background noise level measurements at representative locations around the project site were taken on April 21 and April 23, 1999. Rural background measurements were taken during the daytime and nighttime at two locations on Garvin Mesa and at one location next to State Highway 133. Daytime and nighttime background noise readings were also taken at several locations in Paonia and Hotchkiss. Some of the monitoring stations at Paonia and Hotchkiss were later used to measure noise levels caused by passing coal trains.

In general, the background noise measurements taken at night on Garvin Mesa were 36 dBA, with the predominant noises being natural bird sounds. Routine daytime noise levels in the urban residential areas were 48 to 56 dBA, with the predominant sounds produced by routine local traffic. At the rural site near State Highway 133, the spot check measurements showed 41 to 49 dBA during brief periods of no discernable traffic and spot noise levels of 64 dBA during the brief period while a coal truck drove past.

Environmental Consequences: The mining equipment at the Bowie No. 2 Mine causes little direct noise impacts at the nearest homes. However, the mining equipment at Oxbow possibly exceeds the state of Colorado noise emission limits, and possibly causes noise impacts at the nearest homes in Somerset.

Issuance, and subsequent mining, of the Iron Point and Elk Creek Coal Lease Tracts would increase the number of coal trains passing through Paonia and Hotchkiss as compared to existing conditions. Homes next to the tracks with no shielding by adjacent buildings would be subjected to noise impacts. However, the increase in coal trains would have only a minor impact or no impact on homes more than about one-half block from the tracks with reasonable shielding by adjacent buildings.

Issuance, and subsequent mining, of the Iron Point Coal Lease Tract would increase the number of coal trucks traveling on State Highway 133 between the Bowie No. 2 Mine and the Bowie No. 1 Loadout. Noise from the increased coal trucks would cause a noise impact at homes closer than about 200 feet from the highway.

Exploration drilling in the Iron Point Exploration License Area would also generate noise. Based on observations at other mining projects, noise from the drill rigs is expected to be barely audible at a distance of 2 to 3 miles during quiet parts of the day. It is unlikely that the noise levels at any homes sites would be more than 1 dBA above the daytime background.

S-3.13 Land Use

Existing Conditions: Land uses within the region are mining, grazing, agriculture, logging, residential development, and dispersed recreation.

There is a mixture of federal and private lands within the two coal lease tracts and the exploration license area, as follows:

- Forest Service - 59%
- BLM - 26%
- Private - 15%

All coal within the two coal lease tracts and the coal exploration license area is federally controlled.

Environmental Consequences: In the long-term, following mining, the area within and surrounding the coal lease tracts would be used much as it was before any mining. Any surface subsidence caused by underground mining would be minimal and would not affect the pre-mining land use. The reclamation and revegetation techniques to be undertaken on any disturbed sites are comparatively simplistic, commonly accepted techniques with a history of successful application in the western states.

S-3.14 Transportation

Existing Conditions: The major transportation route servicing the Paonia-Somerset area is State Highway 133. This highway serves local residents and associated commercial traffic for the local communities, including the mining operations in the North Fork Valley. State Highway

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133 is an asphalt, all-weather, two lane highway, that joins the community of Carbondale with the town of Hotchkiss.

Highway traffic counts are identified as annual average daily traffic (ADT). ADT is defined as the measure of traffic over a 24-hour period and is determined by counting the number of vehicles passing a specific point in either direction. The Colorado Department of Transportation has estimated annual 1996 ADT values based on actual traffic counts made at various locations along State Highway 133. The 1996 ADT values on State Highway just east of Paonia is 3,150. At Somerset, the ADT for State Highway 133 was 2,000 in 1996.

The mines in the North Fork of the Gunnison River Valley are accessed by a railroad spur that connects a main Union Pacific Railroad line in Grand Junction, Colorado with the mining operations. This spur line is known as the North Fork Branch and is approximately 95.5 miles in length. The railroad passes through the communities of Delta, Hotchkiss, Paonia, and Somerset. In 1998, 850 coal trains utilized the North Fork Branch. This translates to an average of 2.5 trains per day. An estimated 8.6 million tons of coal were shipped in 1998.

Environmental Consequences: If leased, and subsequent mining occurs on the coal lease tracts, and exploration activities occur in the exploration license area, there would be an increase in daily traffic on State Highway 133. Similarly, if production expands from the mining operations in the North Fork Valley, there would be a resulting increase in daily rail traffic on the North Fork Branch. The magnitude of effects associated with traffic related activities would depend on the amount of coal produced and sold from the mines.

If coal production at the Bowie No. 2 Mine is increased from 1.2 million tons in 1998 to a projected 5 million tons in 2000, coal truck ADT on State Highway 133 between the Bowie No. 2 Mine and the Bowie No. 1 Loadout would increase from 234 to 978, a 400 percent increase. In 1998, the coal truck traffic from the Bowie No. 2 Mine represented approximately 7 percent of the traffic on State Highway 133 between the mine and the loadout. If production is increased to 5 million tons per year in the year 2000 and beyond, the coal truck traffic would represent approximately 21 to 22 percent of the total traffic on that stretch of State Highway 133 between the mine and the loadout. Other than coal traffic, general exploration and mine related traffic would involve only a very minor increase to ADT levels on State Highway 133 between Paonia and Somerset.

Projections call for coal production to increase from the North Fork Valley coal mines from 1998 to 2005. This production increase would relate to additional train traffic on the North Fork Branch. If production increases to 19.2 million tons in 2005, there would be an average of ten trains per day (five loaded and five empty) on the rail line. In 1998, with 8.6 million tons of coal shipped on the Union Pacific Railroad from the North Fork mines, it is estimated the average interval between trains was 5 hours and 27 seconds. If coal production increases to 19.2 million tons in the year 2005, the average interval between trains would be 2 hours and 24 seconds.

With the potential increase in daily traffic, particularly the increase in coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout, it is reasonable to assume that accidents could increase over the life of any mining activities. However, the increase in accidents would probably not be directly proportional to the increase in traffic because mitigation measures

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would include the trucking company using trained drivers, the adherence of the coal trucks to speed limits, and a general public awareness of increased traffic.

With the potential increase in daily coal train traffic, it is reasonable to assume that, the potential for highway vehicles and train accidents at rail crossings could increase. Delays at train crossings could also have impact on public safety. Ambulance service, as well as police and fire response times, could be delayed five to seven minutes when crossing are blocked.

S-3.15 Socioeconomics

Existing Conditions: As of 1998, approximately 26,600 residents live in Delta County and 12,475 residents live in Gunnison County. Population in both counties is forecast to increase at an annual rate of just over 2 percent for the next 20+ years.

Both Delta and Gunnison counties have experienced substantial job growth in recent years, though mining activity is a smaller proportion of the employment base. The mines in the North Fork Valley have restructured to achieve substantially greater productivity in a more competitive domestic and global market.

The primary study area is served by two ambulance districts, five fire districts, municipal police, and county sheriff services. Municipal water service is available in all incorporated communities of Delta County, and municipal sewage/waste water treatment is available in all incorporated jurisdictions except Orchard City. Electric service is available in Delta and Gunnison counties through Tri-State Generation and Transmission Association and its local affiliates: Delta-Montrose Electric Association and Gunnison Electric Association.

Medical services are provided through Delta Hospital, which is a full service, general acute care hospital. This hospital has 49 beds, home health care, a staff of 28 doctors, and 198 full-time and 89 part-time employees.

The federal government receives royalties from mining of federal coal. The state of Colorado receives tax revenues primarily from federal royalties, sales, severance, and income taxes. Local governmental entities receive property, sales, and severance taxes, as well as a share of the federal royalties.

The state of Colorado and local jurisdictions in Delta and Gunnison counties currently receive an estimated $11.4 million in combined annual tax revenue related to operation of the Bowie No. 2 and Oxbow mines and mine-related employees. Of this amount, 52 percent accrues to the state government and 48 percent to the local governments in Delta and Gunnison counties.

Communities along the North Fork of the Gunnison River have a long history with coal mining extending back to the late 1880s. Over 60 percent of the households in Delta County are identified with demographic and lifestyle characteristics of "rustic living." These households tend to come from a traditional and/or remain actively involved in making a living from the land, including agriculture, mining and construction. Whether or not coal mining is viewed as having a positive or negative effect on the quality of life depends on values that receive greatest emphasis from different residents of the North Fork region, and in part on resident dependence on natural resource related industries.

Environmental Consequences: Socioeconomic effects of the No-Action Alternative would occur due to a reduction in coal mine activities within the region. Under the No-Action Alternative, mining of reserves at existing mines would continue at current extraction rates until reserves are completed. Combined effects of discontinuing operations at the Bowie No. 2 and Oxbow mines would represent loss of 383 jobs. Averaging $59,500 in annual salary, the total lost payroll would approximate $22.8 million annually.

For every mine worker in the local study area, an estimated 1.7 workers are supported by mine operations and mine worker household purchases. If both mines were to close, then an estimated 650 locally supported non-mine jobs in Delta and Gunnison counties could potentially be negatively affected due to the drop in mining activity. Total direct and indirect mine closure affects could represent a loss of up to 1,033 jobs and over $34.6 million in annual payroll.

If both mines ceased operations, more than 800 residents (145 of school age) would be directly affected. Whether these people would remain in the area would depend on whether people chose to relocate elsewhere to find employment or remain in the local study area. Combined, these two mine closures could affected nearly 2,380 residents living in the local study area, over 410 of them school aged children.

Under the No-Action Alternative, community and public service providers would be affected by a combination of direct and indirect effects. If not offset by alternative sources of revenue, the level of service available from existing providers could decline. With cessation of the Bowie and Oxbow operations, the state of Colorado and local jurisdictions in Delta and Gunnison counties could lose an estimated $11.4 million in combined annual tax revenue. In addition, local government would lose a portion of the following estimated annual revenues resulting from closures of the Bowie and Oxbow operations: $5.7 million in federal royalties, $2.1 million in state severance tax, and $1.8 million in state sales tax.

With the implementation of any of the action alternatives (B, C, and/or D), there would be no significant changes in mine employment and the socioeconomic effects would be viewed as a continuation of existing effects. The action alternatives (B, C, and D) would allow continued mining for a period of approximately 5 to 8 years beyond what is expected with the No-Action Alternative. It is also conceivable that the life of North Fork mines could be extended further if operators successfully secure unmined seams on private lands or added federal leases.

During any production from the Iron Point and Elk Creek Coal Lease Tracts, state of Colorado and local jurisdictions in Delta and Gunnison counties would receive approximately $13.5 million annually in tax revenues. In addition, mining on the two lease tracts could generate an estimated income of $6.7 million in federal royalties, $2.4 million in state severance taxes, and $1.8 million in state sales tax. Taxes could fluctuate year-to-year as the mines acquire new equipment, make capital improvements, and as the values of such equipment and improvements depreciate. Taxes and royalties would also be influenced by factors such as the price of coal, coal markets, and mine employment.

Tax revenues and royalties would continue for the life of any mining. Upon project closure and reclamation, employment would be lost, directly and indirectly affecting the local communities in the North Fork Valley. In addition, tax and royalty revenues would cease. Other impacts would be similar to those described for the No-Action Alternative.

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Chapter 1

Purpose and Need for Action

1.0 PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

This Environmental Impact Statement (EIS) considers three proposed actions involving federal coal lands, and is a joint document between the United States Department of the Interior (USDI), Colorado State Office, Bureau of Land Management (BLM) and the United States Department of Agriculture (USDA), Forest Service, Grand Mesa-Uncompahgre-Gunnison National Forests (GMUG). The USDI, Office of Surface Mining Reclamation and Enforcement (OSM), Western Regional Coordinating Center is participating as a cooperating agency. The three actions include two lease-by-applications (LBA), and a request for an exploration license which were filed with the BLM under provisions found in 43 CFR 3400.

The locations of the two LBA tracts and the exploration license area are shown in *Figure 1, General Location Map*. The lands involved encompass BLM lands in the Uncompahgre Basin Resource Area, and National Forest System Lands administered by the GMUG. The west tract is known as the Iron Point Tract. The BLM assigned this tract serial number COC-61209. The LBA tract to the east is known as the Elk Creek Tract and was assigned serial number COC-61357. The exploration area is within and north of the Iron Point Coal Lease tract and was assigned serial number COC-61945.

This EIS documents the environmental analysis of the proposed decisions regarding the possible offering of the two federal coal lease tracts and the approval or denial of an exploration license in accordance with the National Environmental Policy Act (NEPA). The EIS process provides a forum for public review and comment on the two LBA tracts and the exploration license area, with their associated relevant issues and the environmental analysis. This document has been assembled to disclose the potential impacts and to provide the decision-makers with information needed to make decisions that are fully informed and relevant to the specifics of the LBA and exploration license submittals. This EIS also documents the process used to analyze the submittals and alternatives to the requests, the environmental impacts, and possible mitigation measures to be included as stipulations in the event the leases are issued and the exploration license is approved.

1.2 BACKGROUND

Coal was originally discovered along the North Fork of the Gunnison River in the late 1880's, and underground coal mining has occurred subsequently in this area for the past 100 years. Bowie Resources Ltd. (Bowie), Oxbow Mining Inc. (Oxbow) and Mountain Coal Company (Mountain Coal) currently operate underground coal mines in this area.

In August of 1997, Bowie filed a coal lease application with the BLM for a tract designated as the Iron Point Coal Lease Tract (COC-61209). This tract covers approximately 3,403 acres of federal coal in Delta County, Colorado, and is shown on *Figure 1, General Location Map*. The Iron Point Tract contains a mixture of federal (BLM and Forest Service) and private surface ownership. See *Figure 2, Surface Ownership Map*. Details regarding the Iron Point Tract are set forth in *Appendix A, Lease Tract Information*. This appendix contains the legal description and estimated reserves of the Iron Point Coal Lease Tract.

In November of 1997, Oxbow filed a lease application with the BLM for approximately 3,703 acres of federal coal in Delta and Gunnison counties, Colorado. This tract was designated the Elk Creek Tract (COC-61357) by the BLM. Oxbow's lease application was amended by the BLM, during tract delineation, to include an additional 160 acres in Section 32, Township 12 South, Range 90 West. The additional area was incorporated into the Elk Creek Tract to ensure that federal coal for which there was adequate coal data was included to avoid a potential future bypass of coal. The tract, as amended, now covers approximately 3,863 acres and is shown on *Figure 1, General Location Map*. This tract contains a mixture of both federal (BLM and Forest Service) and private surface ownership. See *Figure 2, Surface Ownership Map*. Oxbow owns some of the surface and has obtained rights from other surface owners to access the private land. The legal description and estimated reserves for the Elk Creek Coal Lease Tract are set forth in *Appendix A, Lease Tract Information*.

In May of 1998, Bowie submitted an application for a coal exploration license (COC-61945) on unleased lands within and adjacent to the Iron Point Coal Lease Tract. The exploration license area contain approximately 6,053 acres and is shown on *Figure 1, General Location Map*. Most of the surface contained in the coal exploration license application are managed by the BLM and the Forest Service.

There is a total of approximately 11,600 acres in the project area. Surface ownership of this area is approximately 59 percent Forest Service, 26 percent BLM, and 15 percent private. See *Figure 2, Surface Ownership Map*. All of the coal estate is federally administered.

Separate environmental assessments (EA) were prepared on the two lease tract applications (as amended by BLM's tract delineation), but not on the requested exploration license. In January of 1999, as part of the NEPA public process, the BLM and the Forest Service determined that the requirements of NEPA would be best served by preparing a consolidated EIS for the two coal lease tracts and the exploration license area.

1.2.1 Iron Point Exploration License (COC-61945)

An exploration license plan has been submitted to the BLM in accordance with 43 CFR 3410.2-1. The legal description for the coal exploration area is set forth in *Appendix A, Lease Tract Information*. Exploration licenses can be granted for the exploration of unleased federal coal deposits. Pursuant to the Mineral Leasing Act of 1920, as amended, and to 43 CFR 3410, interested parties can participate with the original applicant in a program for the exploration of unleased federal coal. Any party electing to participate in an exploration license program must share all costs on a pro rata basis with the applicant and with any other party or parties who elect to participate.

In June of 1998, the BLM published a Notice of Invitation in the Delta County Independent in accordance with 43 CFR 3410.2-1(c)(1) describing the exploration license plan area and inviting any parties who are interested to participate in the exploration program. Bowie Resources, Ltd. was the original applicant; Ark Land Company (an affiliate of Mountain Coal Company) has elected to participate in this exploration program.

1.2.2 Iron Point Coal Lease Tract (COC-61209)

Bowie has filed an LBA with the Colorado State Office of the BLM to obtain a federal coal lease pursuant to provisions found at 43 CFR 3425.1. This lease tract has been designated as COC-

61209. As applied for, lease tract COC-61209, also identified as the Iron Point Coal Lease Tract, contains approximately 3,403 acres from which D coal seam reserves would be extracted. The legal description for the Iron Point Coal Lease Tract is set forth in *Appendix A, Lease Tract Information*.

1.2.3 Elk Creek Coal Lease Tract (COC-61357)

Oxbow has filed an LBA with the Colorado State Office of the BLM to obtain a federal lease pursuant to provisions found at 43 CFR 3425.1. This lease tract has been designated as COC-61357. As originally applied for and later amended by the BLM, Lease Tract COC-61357, also identified as the Elk Creek Coal Lease Tract, contains approximately 3,863 acres from which D coal seam reserves would be extracted. The legal description for the Elk Creek Coal Lease Tract is set forth in *Appendix A, Lease Tract Information*.

1.3 PURPOSE AND NEED

Both the BLM and the Forest Service maintain policies which allow private industry to explore, develop, and mine coal reserves on federal lands.

Pursuant to the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1976, the BLM administers a coal leasing program to allow the private sector to mine federally owned coal reserves. Under the terms of this law, the BLM is charged with the administration of the coal mineral estate on federal lands and is required to lease coal for economic recovery. Consent by the surface management agency (in this case the Forest Service) is required before BLM can proceed with leasing.

Pursuant to the Mining and Minerals Policy Act of 1970, the Forest Service administers its mineral program to:

1. Encourage and facilitate the orderly exploration, development, and production of mineral and energy resources within the National Forest System in order to maintain a viable, healthy minerals industry and to promote self-sufficiency in those mineral and energy resources necessary for economic growth and the national defense;

2. Ensure that exploration, development, and production of mineral resources are conducted in an environmentally sound manner and that these activities are considered fully in the planning and management of other National Forest resources; and,

3. Ensure that lands disturbed by mineral and energy activities are reclaimed for other productive uses.

The Forest Service considers mineral exploration and development to be important parts of its management program. It cooperates with the USDI (through its agent the BLM) in administering lawful exploration and development of leaseable minerals. While the Forest Service is mainly involved with surface resource management and production, it recognizes that mineral exploration and development are ordinarily in the public interest and can be compatible in the long run, if not immediately, with the purposes for which the National Forest System Lands are managed.

Under the Federal Leasing program, the USDI combined major federal coal management responsibilities into one unified program in order to:

1. Give the nation a greater assurance of being able to meet its national energy objective;
2. Provide a means to promote a more desirable pattern of coal development with ample environmental protection;
3. Assure that state and local governments participate in decisions about where and when federal coal production will take place;
4. Increase competition in the western coal industry.

Under regulations of the Mining and Mineral Policy Act and the Federal Land Policy Management Act, responsible federal agencies must ensure the following:

1. Adverse environmental impacts on public land surface resources are minimized to the extent practical;
2. Measures must be included to provide for reclamation, where practicable; and,
3. The proposed operation will comply with other federal and state laws and regulations.

A discussion of the responsibility of the BLM and the Forest Service, as well as other federal, state, and local agencies, with regard to coal leasing and mining are set forth in *Appendix B, Agency Jurisdictions (Permits and Approvals)*.

With the preparation of this EIS, the BLM and Forest Service are responding to the coal lease tract applications submitted by Bowie and Oxbow, as well as the exploration license application submitted by Bowie. The purpose and objectives for Bowie and Oxbow with regard to the Iron Point and Elk Creek Tracts, respectively, are to continue their coal mining operations as is technically and economically possible, at a maximum rate of return for its investors, consistent with applicable company, state, federal, and local environmental permitting and operational requirements.

This EIS is prepared to inform federal agency decision-makers and publically disclose the probable environmental impacts of coal leasing and exploration, present a range of reasonable alternatives, and provide for possible mitigation measures in the event the leases and exploration license are approved.

Bowie requested the Iron Point Coal Lease Tract in order to obtain reserves to supply potential customers and in order to economically justify the installation of a longwall system. The federally owned coal deposits in the Iron Point Coal Lease Tract are a logical extension to existing operations at the Bowie No. 2 Mine.

Bowie has also filed for an exploration license in order to obtain additional information regarding coal resources within the Iron Point Coal Lease Tract and areas to the north of the Iron Point

Coal Lease Tract. Such exploration is required to further delineate the extent of the coal resources in this area, as well as to obtain coal quality information on the coal.

Oxbow applied for the Elk Creek Coal Lease Tract as a logical extension to its existing mining. Oxbow presently operates with a longwall system of underground mining. Although mining at the Sanborn Creek Mine was curtailed for the first half of 1999 due to a fire in the mine, Oxbow has recently reinitiated mining operations. Acquisition of the Elk Creek Coal Lease Tract would be a logical future extension of current mining by Oxbow.

1.4 PROPOSED ACTIONS

There are three proposed actions associated with this EIS:

- Lease the Iron Point Coal Lease Tract on federal lands in Delta County, Colorado, for underground coal mining; and,
- Lease the Elk Creek Coal Lease Tract on federal lands in Delta and Gunnison counties, Colorado, for underground coal mining;
- Issue an exploration license for coal exploration on federal lands in Delta County, Colorado.

These actions, along with the No-Action Alternative, are discussed in detail in Chapter 2.0, Alternatives Including the Proposed Actions, of this EIS document.

1.5 DECISIONS TO BE MADE

The BLM and the Forest Service are the joint lead agencies responsible for completion of this EIS. OSM is a cooperating agency in this EIS. OSM will prepare any Mineral Leasing Act mining plan decisions related to these leases. These agencies are following specific procedures that began with scoping and data collection and continued with analysis of data and evaluation of alternatives. The information and analysis conducted for the original EAs are incorporated into the EIS. In accordance with regulations implementing NEPA (40 CFR 1500), the results of the environmental analysis within this EIS will form an important part of the leasing decisions to be made on the Iron Point and Elk Creek Coal Lease Tracts, as well as the exploration license application for the Iron Point area. Even though the applications were submitted by private companies, the applications are processed under BLM's LBA process (43 CFR 3425) and, if approved for leasing, would be offered by competitive bid. Granting a lease only gives exclusive rights to the coal resource; it does not authorize mining.

The information and data submitted in the coal lease applications by Bowie and Oxbow do not constitute a formal underground mining permit application package to either the OSM or the Colorado Division of Minerals and Geology (DMG). This coal lease application information has been used solely to develop an impact analysis in the EIS. Its use is intended to illustrate one possible development scenario for developing federal coal reserves on the lease tracts and does not imply that either Bowie or Oxbow would be given any preference in the event that lease sales are held.

After the close of the Draft EIS review and comment period, the BLM and Forest Service will consider comments submitted by the public, interested organizations, and government agencies (federal, state and local), and will respond to those comments in a Final EIS. OSM, which is a cooperating agency on this EIS, will assist the lead agencies with responses to comments pertinent to areas of their jurisdiction and expertise, as requested by the BLM and Forest Service.

In accordance with 40 CFR 1503.4, the joint lead agencies will consider comments and respond to these comments by:

1. Modifying alternatives;
2. Developing new alternatives;
3. Modifying the analysis;
4. Making corrections; or
5. Explaining why comments do not warrant further agency response.

After the release of a Final EIS, the BLM and Forest Service will issue Records of Decision regarding their respective decisions on the leasing applications and exploration license.

The Colorado State Director, BLM, is the NEPA responsible signatory official for the BLM and will decide whether or not to offer the tracts for competitive leasing under the Mineral Leasing Act of 1920, as amended, and the federal regulations under 43 CFR 3400. The Uncompahgre Field Office Manager is responsible for the preparation of the EIS and providing the State Director with briefings and recommendations. In the Records of Decision, the BLM responsible official may decide to:

- Adopt the No-Action Alternative (no leasing and/or exploration license);
- Adopt the proposed actions (lease the coal as applied for by the applicants and/or grant the exploration license);
- Adopt an alternative with features of several of the alternatives; or
- Adopt one of the action alternatives with additional mitigation measures.

The Forest Supervisor of the GMUG is the NEPA responsible official for the Forest Service. The Forest Supervisor must decide whether or not to consent to the BLM leasing National Forest System Lands according to the Federal Coal Leasing Amendments Act of 1976. The Forest Supervisor must also prescribe terms and/or conditions (through lease stipulations) with respect to the use and protection of non-mineral interests. Once the Records of Decision are signed and released, and if the leases are issued, the BLM would be responsible for lease administration and enforcement of lease terms and conditions. Similar decisions by the authorizing officers are required for approval of the exploration license.

If one or both of the coal leases are issued and before any mining or surface development could occur, the lessee or operator would be required to submit a Permit Application Package (PAP) under the Surface Mining Control and Reclamation Act (SMCRA). SMCRA would give OSM primary responsibility to administer programs that regulate the surface effects of underground coal mining. Pursuant to Section 503 of SMCRA, the Colorado DMG developed, and the Secretary of the Interior approved a permanent program authorizing the Colorado DMG to regulate surface coal mining operations and the surface effects of underground mining on non-federal lands within the state of Colorado. In September of 1982, pursuant to Section

523(c) of SMCRA, the Colorado DMG entered into a cooperative agreement with the Secretary of the Interior authorizing the Colorado DMG the right to regulate the surface effects of underground mining on federal lands within the state of Colorado. The governing regulations for coal mining in the state of Colorado are the 34-33-101 *et. seq.* of the Colorado revised statutes.

Pursuant to the cooperative agreement, a federal coal lease holder in Colorado must submit a PAP to both the OSM and the Colorado DMG for any proposed coal mining and reclamation operation on lands within the state. The Colorado DMG reviews the PAP to ensure that it complies with the permitting requirements and that the coal mining operation will meet the performance standards of the approved Colorado program.

The OSM, BLM, Forest Service and other appropriate federal agencies would review the PAP to ensure that it complies with terms of the coal lease (including any special conditions of approval), the Mineral Leasing Act of 1920, NEPA, and other federal laws and their attendant regulations.

If compliance is met, the Colorado DMG would issue the applicant a permit to conduct coal mining operations. Under the authority of the Mineral Leasing Act of 1920, OSM would then recommend approval, approval with conditions, or disapproval of the permit to the Assistant Secretary of the Interior, Land and Minerals Management. Before the permit can be approved, the BLM must concur with this recommendation, and approve a Resource Protection and Recovery Plan under 43 CFR 3482. The Forest Service must also consent/concur to the mine permit prior to its issuance.

As part of the Colorado DMG permitting process, a new mining and reclamation plan or an amendment to an existing plan would be developed to show how lands in the lease tract and private/other federal owned coal would be mined and reclaimed. Specific impacts that would occur during mining would be addressed in the permit or revision, and specific mitigation measures for anticipated impacts would be identified at that time.

The Colorado DMG enforces the performance standards and permit requirements for reclamation during a mine's operation and has primary authority in environmental emergencies. OSM retains oversight responsibility for this enforcement. The BLM and Forest Service also have authority in those emergency situations where the Colorado DMG or OSM can not act before environmental harm and damage occurs.

Additional details regarding federal, state, and local government agency responsibilities are set forth in *Appendix B, Agency Jurisdictions (Permits and Approvals).*

1.6 CONFORMANCE WITH LAND USE PLANS

1.6.1 BLM Resource Management Plan Consistency

The proposed actions are in compliance with the existing BLM land use plan. The Uncompahgre Basin Resource Management Plan (RMP) was completed, and approved in July of 1989. This RMP determined that the areas subject to the lease applications and exploration license applications were to be managed for both existing and potential coal development. The area is acceptable for coal development and coal production, and such coal activities could occur without conflicting with other land uses as described in the RMP.

Upon receipt of the lease applications, BLM completed tract delineation. The assessment of coal unsuitability criteria has been completed for both the proposed Iron Point Coal Lease Tract (COC-61209) and the Elk Creek Coal Lease Tract (COC-61385). The criteria has also been reviewed for implications with the other alternatives in this analysis. The unsuitability criteria published in 43 CFR 3461 were used. These coal unsuitability analysis reports are included in this EIS document as *Appendix C, Unsuitability Analysis Report - Iron Point Tract (COC-61209)*, and *Appendix D, Unsuitability Analysis Report - Elk Creek Tract (COC-61385)*. In addition, data adequacy standards were reviewed and determined to be adequate.

The land use plan was amended to address the standards for land health (i.e., Standards and Guidelines). The land analyzed in the EIS project area is within the North Fork landscape unit. This unit has not been assessed for landscape health under the BLM's Standards and Guidelines procedures and little information on land health is available. A landscape health assessment is scheduled for the summer of 2000. Briefly, Colorado BLM's Standards are:

- Ensure health of upland soils;
- Protect and improve riparian systems;
- Maintain healthy, productive plant and animal communities;
- Maintain or increase populations of threatened and endangered species in suitable habitat; and
- Ensure water quality meets minimum Colorado standards.

The proposed action deals primarily with underground mining. Only minor surface disturbing activities would occur on BLM managed lands. Consequently there is little potential for actions to have a significant effect (positive or negative) to the landscape as a whole. There would be local effects where surface disturbing activities occur. For example, there would be increased potential for soil erosion and influx of weeds. It is assumed mitigation would avoid or lessen the impact. When the land health assessment is completed, BLM will determine if the land health standards are being met. If they are not being met, the causative factors will be determined and options for improvement formulated. If any permitted activities are found to affect land health, then modifications to operations as authorized by BLM will occur.

1.6.2 Forest Plan Consistency

The amended Land and Resource Management Plan (LRMP) dated September 1991, for the GMUG National Forests made provisions for coal leasing subject to the application of the coal unsuitability criteria established in 43 CFR 3461. (See *Appendix C, Unsuitability Analysis Report - Iron Point Lease (COC-61209)*, and *Appendix D, Unsuitability Analysis Report - Elk Creek Lease (COC-61385)*.) The LRMP also provided for applicable stipulations to be utilized for protection of specific surface resources as addressed in Section III, General Direction, pages 63-69 of the LRMP.

The Forest Plan guides all natural resource management activities and establishes management standards and guidelines for the GMUG. Management directions described in the Forest Plan are a result of public issues, management concerns, and management opportunities. Multiple use management area prescriptions as designated in the Forest Plan (pages III-114 to 187) for the lands bounded by the two proposed lease tracts and the exploration license are summarized below.

4B - Wildlife habitat management for one or more management indicator species. Emphasis is on optimizing habitat capability for management indicator species. Other resource activities may occur, as long as habitat requirements are maintained.

4D - Aspen Management. Emphasis is on managing aspen to produce wood fiber, visual quality and plant and animal diversity while maintaining and improving aspen sites on summer range. Other activities may occur as long as management goals and objectives are maintained.

9A - Riparian/Aquatic Ecosystems. Emphasis is on the management of all the components of aquatic/riparian ecosystems to provide healthy, self-perpetuating plant communities, acceptable water quality standards, habitats for viable populations of fish and wildlife, and stable stream channels and still water body shorelines. Mineral activities may occur but must minimize disturbance to riparian areas and initiate timely and effective rehabilitation of disturbed areas and restore them to state of productivity comparable to that before disturbance.

1.7 PUBLIC AND AGENCY PARTICIPATION AND INVOLVEMENT

As required by NEPA (40 CFR 1501.7), the BLM and the Forest Service have provided for an early and open process to determine the scope of issues to be addressed and to identify the issues related to this EIS. Elements in the scoping process included the following:

- Publication of a Notice of Intent to prepare an EIS in the Federal Register (dated April 13, 1999);
- The description of the Purpose and Need, and the Proposed Actions including the nature of the decisions to be made;
- The collection of existing data and information to address the two potential lease tracts and the exploration license area;
- The initiation of public and government participation in the EIS process;
- The determination of the type and extent of analysis to be used in the preparation of the EIS;
- The identification of government agencies involved and appropriate responsible officials from the lead and cooperating agencies; and,
- The plans for the preparation of the EIS, including selection of a format for the document and development of a schedule for EIS completion and publication.

As mentioned in Section 1.2, Background, EAs were originally prepared on the lease applications. Relevant information from the EAs has been incorporated into this EIS. In addition, the Delta/Montrose Public Land Partnership and North Fork Coal Working Group sponsored several community meetings regarding coal development in the North Fork Valley. Issues, concerns, and comments identified in those meetings are also incorporated into this EIS.

1.7.1 Agency Meetings and Scoping

On April 22, 1999, the BLM and Forest Service held an agency scoping meeting to discuss this EIS. Representatives from the BLM, Forest Service, OSM, Colorado DMG, Colorado Division of Wildlife, Delta County, and Gunnison County were present. On April 28, 1999, the lead agencies met with representatives from the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service. On May 18, 1999, the lead agencies met with representatives of the Environmental Protection Agency. In addition, a project description and vicinity map were sent to the Northern Ute Tribe.

The purpose of these meetings were to familiarize these various federal, state, and local agencies regarding the various aspects of the North Fork Coal EIS and solicit their input on any issues regarding the planned work and the proposals.

1.7.2 Public Scoping

As required by NEPA (40 CFR 1503), the general public, businesses, special interest groups, and government agencies were provided the opportunity to become informed and comment on this EIS process. The BLM and the Forest Service accomplished these goals by holding agency and public scoping meetings; public mailings; publishing of a Notice of Intent in the Federal Register; forming an interdisciplinary (ID) team; and preparing a scoping document.

The formal scoping process began on April 13, 1999 and ended on May 17, 1999. The BLM and the Forest Service held a public scoping meeting in Hotchkiss, Colorado on April 21, 1999.

From input at the public meetings and from written comments, issues specific to the two potential coal lease tracts and the exploration license application were summarized and used as part of the criteria for completing this EIS document. Issues were used by the ID team for developing and screening alternatives, and evaluating consequences of the proposed actions. A synopsis of the issues identified for the proposed lease tracts and exploration license area is set forth in Section 1.8, Issues and Concerns, of this EIS document.

In April and July 1999, newsletters were sent to individuals, organizations and agencies on the North Fork Coal EIS mailing list to inform them on progress of the EIS and provide relevant information.

1.8 ISSUES AND CONCERNS

Scoping was conducted to focus the EIS on those issues and concerns considered important to the public and various government agencies. A scoping summary document was prepared and made publically available in July 1999.

Issues are areas of discussion, debate or dispute about the effects of proposed activities on various resources. Scoping is the procedure used to determine the extent of the analysis necessary to make informed decisions on the project proposals. From scoping input, issues specific to the proposed leasing and exploration license applications were summarized and used as part of the criteria for completing this EIS. Issues also were analyzed by the ID team for evaluating alternatives and assessing consequences.

The following are issues that are addressed in this EIS:

- Air Quality
- Aquatic Resources/Fisheries
- Cultural Resources
- Cumulative Impacts
- Geology/Geotechnical Issues/Subsidence
- Health/Safety
- Land Use
- Noise
- Reclamation
- Recreation
- Socioeconomics
- Surface Water and Ground Water
- Transportation
- Vegetation
- Visual Resources/Lighting
- Wetlands
- Wildlife

1.8.1 Air Quality

Identify and minimize air quality impacts. Areas of concern include: the effects on air quality from fugitive dust and gaseous emissions; air quality impacts (visibility) on the West Elk Wilderness Area; and cumulative air quality effects.

1.8.2 Aquatic Resources/Fisheries

Minimize disturbance to fish habitat and fish populations. Areas of concern include: direct disturbance of stream channels; reduced flow; stream sedimentation; water quality degradation; and impacts to threatened and endangered aquatic species.

1.8.3 Cultural Resources

Identify cultural resources and minimize disturbance impacts to these resources. Areas of concern include the effects to historic properties listed or eligible for listing on the National Register of Historic Places.

1.8.4 Cumulative Impacts

Address the cumulative impacts of leasing and exploration with other potential projects. Areas of concern include: the influence of mining from the Iron Point and Elk Creek Coal Lease Tracts in association with other mining activities in the area, especially the cumulative effects of coal transportation from the North Fork of the Gunnison River area and the socioeconomic effects to the economies of Delta and Gunnison counties.

1.8.5 Geology/Geotechnical Issues/Subsidence

Identify geologic hazards on the lease sites and the potential for subsidence by underground mining activities. Areas of concern include: the potential influence of geologic hazards; the potential for and consequences of subsidence; and, the effects of mining on the area's geology; the potential impact of mining and subsidence on the Curecanti-Rifle 230/345 kV electric transmission line that runs parallel to Terror Creek; and the potential effects to Terror Creek and the Terror Creek Reservoir by mining.

1.8.6 Health/Safety

Protect worker health and safety. Identify the emergency response measures that would be available in the event of a train derailment, fire, or explosion. Areas of concern for worker health and safety include: the risks from underground operations; the potential for train derailment in town; the potential responsibility for fighting fires along train right-of-ways; the possibility of an accident that would necessitate an emergency response; and the potential for fires or explosions in the underground mines.

1.8.7 Land Use

Minimize disturbance. Areas of concern include: the acreage of disturbance; the amount of disturbance on BLM, Forest Service, and private lands; and the possible changes in future land use.

1.8.8 Noise

Identify and minimize noise impacts. Areas of concern include; level of noise from coal transportation by truck and railroad; noise from mine ventilation fans; disruptions caused by such noise to the normal activities of adjacent residents/communities; noise from Bowie No. 1 Loadout; and, night time railroad noise in Paonia, Hotchkiss, and Delta.

1.8.9 Reclamation

Provide for reclamation of disturbed areas. Areas of concern include: the successful short-term soil stability and long-term revegetation practices; reclamation of Bowie No. 1 Mine portal; and, the ability to prevent or control damage to the environment.

1.8.10 Recreation

Minimize disturbance to recreational opportunities. Areas of concern include: disruption to recreational opportunities in the undeveloped areas within and adjacent to the coal lease sites caused by background sounds, traffic, subsidence, and accessability.

1.8.11 Socioeconomics

Address the social and economic impacts on local residents of Delta and Gunnison Counties. Areas of concern include: impacts to nearby communities as the result of mine closures or continuation of mining and such impacts on housing, utilities, employment, public services, community services, and present lifestyles; the effect of mine closure on workers and their families; the influx of new workers if production rates increase; and, the effects of temporary and permanent mine shutdown.

1.8.12 Surface Water and Ground Water

Identify and minimize impacts to water quality and hydrology to maintain the integrity of watersheds within and surrounding the lease tract areas. Maintain adequate flows to drainages and ditches above underground mining activity. Areas of concern include: The potential to alter existing hydrologic systems; the potential to impact irrigation canals and the Terror Creek Reservoir by subsidence; alteration of downstream flow rates; alteration of existing springs and seeps; changes in water chemistry as a result of mining operations; and, impacts to water rights on Terror Creek, Hubbard Creek, Bear Creek, and Elk Creek.

1.8.13 Transportation

Address truck and train traffic impacts created by coal mining in the North Fork of the Gunnison Valley and the potential for accidents. Areas of concern include: the amount of train traffic in the area; the ability of the railroad to handle the projected tonnages of coal to be mined from the North Fork of the Gunnison River valley; the increase in traffic as a result of hauling coal to the Bowie No.1 Loadout and the Terror Creek Loadout; the need for an additional rail loadout facility for the Bowie No. 2 Mine; the potential for accidents involving increased train and truck traffic; and, the risks for accidents at railroad crossings in Delta County as well as along sections of State Highway 133 subject to coal truck traffic.

1.8.14 Vegetation

Address the impacts to vegetation as a result of mining and exploration activity. Areas of concern include: the potential effects on threatened, endangered, or sensitive plants; control of noxious weeds; and, the impacts on vegetation as a result of any subsidence or surface disturbance.

1.8.15 Visual Resources/Lighting

Minimize the impacts from lights when operating at night. The concerns include: lighting from the facilities at the Bowie No. 1 Loadout, the Bowie No. 2 Mine, and the Sanborn Creek Mine.

1.8.16 Wetlands

Identify and minimize impacts to wetlands and Waters of the U.S. Areas of concern include: the acres of wetlands lost through direct impact; the changes in functions of values and wetlands and riparian areas as a result of mining and exploration activities; and, the potential effects from subsidence on these areas.

1.8.17 Wildlife

Minimize the disruption to terrestiral wildlife and wildlife habitats. Areas of concern include: the impacts to threatened, endangered, or sensitive species; impacts to big game habitat; loss of habitat and habitat effectiveness; and, impacts associated with continued and/or increased human activity.

1.9 PAST, PRESENT AND REASONABLY FORESEEABLE CUMULATIVE ACTIONS CONSIDERED IN THIS ANALYSIS

A number of activities occur in the area surrounding the two lease tracts and the exploration license area. These activities primarily involve other coal exploration and mining activities, but there is also an electric transmission line, highway construction, agriculture, and logging.

Coal exploration and mining activities have historically and are presently occurring in the areas to the north and south of the North Fork of the Gunnison River near the communities of Paonia and Somerset. See *Figure 3, Historic Coal Mines and Federal Coal Lease Locations*. Current projects within the general vicinity include the Bowie and Oxbow underground mining operations, as well as ongoing exploration and mining activities by Mountain Coal. These actions combined form the basis on which to analyze cumulative impacts.

1.9.1 Bowie No. 1 Coal Mine

At present, the Bowie No. 1 Mine is idle under provisions of a temporary cessation approval from the Colorado DMG. There is no current coal production from this mining operation. The Bowie No. 1 Mine is permitted with the Colorado DMG for a production rate of 1.5 million tons of coal per year. This operation was developed by Colorado Westmoreland Coal Company in the late 1970s, subsequently sold to Cyprus Coal Company who operated the mine until 1998, whereupon it was sold to Bowie. The Bowie No. 1 Mine was operated as a room and pillar type operation, with coal being hauled from the mine portal area to the Bowie No. 1 Loadout near Paonia.

In 1986, an underground mine fire closed the operation. Although the Mine Safety and Health Administration (MSHA) subsequently allowed the mine to re-open, there remains an area of coal reserves to the west of Terror Creek in Federal Coal Lease Tract No. COC-37210. This area of coal reserves is known as the Bowie No. 1 "pod." The fire severely hampered the access to this area, and officials from Bowie indicate that they have been exploring various scenarios that would allow access and recovery of this coal. Refer to Section 2.4.2, Alternative B - Offer Iron Point Coal Lease as Applied for by Applicant, Section 2.5.2, Alternative C - Offer Iron Point Coal Lease for Multi-Seam Mining, and Section 2.6.2, Alternative D - Offer Iron Point Coal Lease With Stipulation That There be no Subsidence in Sensitive Areas.

1.9.2 Bowie No. 1 Coal Loadout

The Bowie No. 1 Loadout is located northeast of the community of Paonia. This facility includes a truck dump area, conveyors, three silos with a capacity of 8,000 tons each, and a batch loadout tower for loading the railroad cars. Presently, Bowie is trucking coal from the Bowie No. 2 Mine to the Bowie No. 1 Loadout. This loadout was originally permitted and constructed by Colorado Westmoreland Coal Company in the late 1970s to serve as the loadout from its mining operations (presently the Bowie No. 1 Mine). Coal is hauled currently from the Bowie No. 2 Mine to the Bowie No. 1 Loadout with highway trucks under a contract between Bowie and Savage Trucking Inc. Bowie has filed a technical revision with the Colorado DMG to increase the tonnage for the Bowie No. 1 Loadout up to 5 million tons per year.

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1.9.3 Bowie No. 2 Coal Mine

Bowie is presently conducting coal mining operations from its Bowie No. 2 Mine, using room and pillar mining techniques. Coal is transported from the underground mine to the portal bench via a conveyor. From the portal coal storage areas, coal is loaded on trucks and hauled to the Bowie No. 1 Loadout.

Bowie has filed a permit revision with the Colorado DMG for the construction and operation of a conveyor which wiould transport coal from the portal bench to a proposed new coal handling, storage and truck loadout area adjacent to old State Highway 133.

The Bowie No. 2 Mine is presently permitted for 2 million tons of production using room and pillar mining techniques. Bowie has submitted a permit revision for a longwall system upgrade to the Colorado DMG. With the installation of a new longwall system, Bowie plans to increase production to 5 million tons per year. If Bowie is the successful bidder for the Iron Point Coal Lease Tract, they would utilize their existing facilities to handle coal mined from this tract.

1.9.4 Sanborn Creek Coal Mine

The Sanborn Creek Mine, operated by Oxbow, is located northeast of the community of Somerset. This mine is permitted with the Colorado DMG for an annual production of up to 4 million tons per year.

At present, Oxbow is rehabilitating the Sanborn Creek Mine as a result of a shutdown in January of 1999 caused when elevated CO and CO_2 were detected in the mine ventilation exhaust. As a result of a mine fire, the mine was sealed and flooded with water. After working with MSHA on safety issues and precautions, Oxbow has recently re-opened the operation.

Coal mined by the longwall system from the Sanborn Creek Mine is conveyed from the underground workings to surface coal handling and loadout facilities located immediately north of the community of Somerset. Recent construction has added additional coal storage capability along with a new batch loadout facility for train car loading.

Oxbow is the applicant for the Elk Creek Coal Lease Tract. Oxbow has filed a technical revision to its current permit with the Colorado DMG and is planning to construct a new portal pad on their private (fee) property in Elk Creek regardless of the outcome of the lease sale for the Elk Creek Tract. If successful in obtaining the lease, Oxbow would use these surface facilities located on private surface to extend its coal mining activities into the Elk Creek Coal Lease Tract.

1.9.5 Terror Creek Coal Loadout

This loadout is a custom coal loadout, with coal being shipped from this facility to specialized customers, such as cement plants and other industrial complexes that use coal. See *Figure 1, General Location Map*, for the location of the Terror Creek Coal Loadout. The Terror Creek Coal Loadout is owned by Oxbow (88%) and the Bear Coal Company (12%), but the facility is operated by Oxbow. This loadout facility is permitted to handle approximately 150,000 tons of coal per year. The coal is hauled from the Somerset facilities by Oxbow-owned highway trucks to the Terror Creek Loadout.

1.9.7 West Elk Coal Mine

The West Elk Mine is located south and east of the community of Somerset, approximately 3 miles from the Elk Creek Coal Lease Tract and 6 miles from the Iron Point Coal Lease Tract. This mine is operated by Mountain Coal Company (a subsidiary of Arch Minerals Company) and is permitted with the Colorado DMG. This mine was opened in the early 1980s, and a longwall system of operation was added in 1991. The West Elk Mine produces coal from several federal coal leases, and the company has worked with the Forest Service on a number of exploration applications in the past.

In 1998, Mountain Coal shipped 5.9 million tons of coal from the West Elk Mine, but projects that it could ship up to 7.3 million tons in 2000 and 8.2 million tons in 2005.

1.9.8 Electric Transmission Line

The Western Area Power Administration owns and operates the Curecanti-Rifle 230/345 kV electric transmission line that essentially parallels Terror Creek, west of the Bowie No. 2 Mine. The right-of-way for this transmission line is 125 feet in width, which includes access roads. The transmission line structures are steel lattice with buried reinforced concrete bases.

1.9.9 Highway 133 Upgrade

State Highway 133 is located adjacent to the North Fork of the Gunnison River and is the main road that accesses the coal mines in the Paonia and Somerset area. This highway connects Hotchkiss with Carbondale, Colorado, and traverses McClure Pass. Over the past 20 years, the Colorado Department of Transportation (DOT) has funded and overseen upgrades and relocations of this highway in an area east of Paonia to the inlet of the Paonia Reservoir. In 1999-2000, the Colorado DOT has contracted for the upgrade of a 5 mile section of State Highway 133 immediately downstream of the Paonia Reservoir. This upgrade will involve straightening, widening, and repaving activities. Other routine maintenance and upgrades will continue in the future.

1.9.10 Agriculture

Agricultural activities have historically been and continue to be a prominent part of the local Paonia economy. Fruit production is generally confined to the valley floors and low mesas/terraces adjacent to the North Fork of the Gunnison River. In recent years, vineyards (and several wineries) have been developed and are being operated in the Paonia area.

Sheep and cattle grazing also occurs on pastureland in the Paonia area, with summer livestock grazing occurring in the higher elevations above the Bowie and Oxbow operations, including lands within and surrounding the proposed Iron Point and Elk Creek Coal Lease Tracts.

1.9.11 Water Storage and Irrigation Canals

To serve agricultural, as well as some domestic use in the area, there are a number of water storage reservoirs and irrigation canals. The Terror Creek Ditch and Reservoir Company operates and maintains the Terror Creek Reservoir (also known as the Bruce Park Reservoir) and Terror Creek Canal to provide water for agricultural and domestic users on Garvin Mesa. The Terror Creek Reservoir and Terror Creek are shown on *Figure 1, General Location Map*.

Other canals, such as the Fire Mountain Ditch, the Deer Trail Ditch and the Steward Ditch, essentially parallel the North Fork of the Gunnison River to provide gravity feed irrigation water for agricultural purposes.

1.9.12 Logging

There is only minimal logging in the vicinity of the two coal lease tracts and the exploration license area. The Hotchkiss Ranch Company has harvested several aspen stands on their property which is located within and surrounding the Elk Creek Coal Lease Tract. Some products other than logs, such as fence posts and fuel wood, have been harvested off federal lands within and adjacent to the coal lease tracts and exploration license areas, but this activity has been limited.

The major timber harvest activities in the region have occurred in the Stevens Gulch area, which is located north of the community of Paonia, Colorado.

1.9.13 Railroad Maintenance/Improvements

The Union Pacific owns and maintains the "North Fork Branch," the rail spur line that provides services to the coal mines in the North Fork of the Gunnison River valley. This spur line is approximately 95.5 miles in length. It originates in Grand Junction and passes through the communities of Delta, Hotchkiss, Paonia, and Somerset Colorado. This line serves the Bowie No. 1 (Converse), Terror Creek, Oxbow, and West Elk coal loadout facilities. In 1998, this spur line handled approximately 850 trains and hauled an estimated total of 8.6 million tons of coal from the various North Fork coal loadouts. The Union Pacific, as part of their normal practice, plans and undertakes a schedule of maintenance and upgrades on this spur line.

1.9.14 Recreation

There are no developed recreational facilities operated by the BLM or Forest Service on the proposed coal lease tracts and exploration license area. Hunting is the primary recreation activity within and adjacent to the proposed coal lease tracts and exploration license area. Other dispersed recreational activities occur in the area, but on a limited basis due to the lack of developed facilities. Four-wheeling, hiking, picnicking, horseback-riding, snowmobiling, and general sight-seeing have been mentioned as occurring.

1.9.15 Housing Development

In recent years, the area within and surrounding the communities of Paonia, Hotchkiss, Crawford, and Delta, Colorado have experienced an influx of population and the construction of new housing. This region of Colorado seems to be attractive to new "migrants" because of a number of factors including the area's natural beauty, low land costs, sparse population, minimal land use controls, and low cost of living. The new housing development is "down-valley" from the proposed coal lease tracts and exploration license area.

1.10 AGENCY JURISDICTIONS (PERMITS AND APPROVALS)

Preparation of an EIS at the leasing stage and the actual mine permitting processes are related but distinct. An EIS is designed to explore alternatives, mitigation measures, and environmental impacts. The permitting processes give individual government decision-makers the authority to grant approvals and issue permits with requirements and conditions to eliminate and/or mitigate specific adverse environmental impacts which are identified in the EIS. See *Appendix B, Agency Jurisdictions (Permits and Approvals)*, for details of tentative approvals and permits needed for exploration and mining activity.

A number of federal, state, and local permits and approvals would be required for actual mining of the coal in the Iron Point and Elk Creek Coal Lease Tracts. See *Appendix B, Agency Jurisdictions (Permits and Approvals)*.

BLM decisions can be immediately effective and are typically issued 30 days after the Final EIS is issued. Forest Service decisions are usually issued with the Final EIS. Implementation occurs after the close of a 45 day appeal period, and a 5 day administrative stay if there are no appeals.

1.11 ISSUES OUTSIDE THE SCOPE OF THIS EIS

The two proposed coal lease tracts and the exploration license area are not located in any areas of critical environmental concern, in or adjacent to the corridor of a designated, eligible or potentially eligible wild and scenic river, prime or unique farmlands, or wilderness areas. There are no effects anticipated on any Forest Service trails in the area. Also, there would be no affects on any wild horses or burros.

Over the past several years, there have been three possible projects in the greater area that could have a cumulative impact. These are the Dominquez Canyon Reservoir, AB Lateral Diversion, and Mount Emmons Molybdenum Mine. At this time, there are no immediate applications or proposals being offered. The future outlook for these projects is speculative at best. Consequently, they are outside the scope of this EIS.

On February 11, 1994, the President issued Executive Order 12898 on environmental justice in minority and low income populations. The purpose of the Order is to identify and address, as appropriate, disproportionately high and adverse human health and environmental effects of programs, policies or activities on minority or low income populations. There are no low income or minority populations that could be disproportionately affected by the proposed actions.

Some issues identified during scoping were not carried forward in the analysis because they were determined to be outside the scope of the EIS, not address the purpose and need, or be outside the agencies' jurisdiction.

A few examples of these types of issues are listed below:

- The EIS should disclose that Oxbow Carbon and Minerals previously requested the BLM to investigate whether or not there could be a lease option sale prior to conducting the EIS, and the reasons for this request: those being that since allegations had been made by credible parties that Bowie Resources Ltd.; intended to bid on Oxbow's proposed lease of federal coal reserves in the Elk Creek Tract, and since the mine operators are paying the third-party contractors developing the EIS, that Oxbow wanted to resolve the competitive bid process prior to paying for the EIS.
- Money invested by Bowie and Oxbow will sway the EIS.

- We need health studies dealing with sleep deprivation, especially in children.
- We must do everything to maintain the balance between coal, agriculture, recreation, tourism, and to preserve the uniqueness of this valley.
- I would like to see an in depth study done on the three major companies, (Bowie, Oxbow, and Mountain Coal) regarding the safety record, the integrity, and the honesty of these companies based on past performance. And I would like to see this information made available to the public.
- Should corporate responsibility be considered by the community?
- Have local mines paid their bills on time and followed the applicable rules and laws?
- To what extent have they been good and/or bad neighbors?
- How about researching methane gas recovery to prevent another mine-closing explosion. A project could be developed to convert the gas to a utility heating plant.
- I would like to inform the people that approximately 80% of the electricity in the U.S. is produced with coal.
- Would government subsidies be required if agencies didn't lease for coal?
- Can we have a broader discussion on energy alternatives and job alternatives?
- We must be weary of all seeking in roads and to foray in pursuit of short sided ambition. Pandering for businesses and corporations must cease.

Chapter 2

Alternatives Including the Proposed Action

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 INTRODUCTION

The discussion of alternatives is the foundation of the Environmental Impact Statement (EIS) process (see 40 CFR 1402.14). The Bureau of Land Management (BLM) and the USDA Forest Service (Forest Service) have explored and evaluated numerous ideas and options during the selection and development of the alternatives which include a No-Action Alternative and the actions as proposed by the applicants for the exploration license and the coal lease tracts. In total, four alternatives (including the No-Action Alternative) have been developed for evaluation in this EIS.

This chapter also includes reclamation, management, mitigation, and monitoring measures which would be associated with the implementation of any of the action alternatives. The environmental consequences associated with each of the alternatives are analyzed in Chapter 3, Environmental Analysis.

The BLM and the Forest Service used engineering, reclamation, and environmental baseline and background information and data to develop this EIS document. There have been visits to the existing Bowie No. 2 Mine, the Sanborn Creek Mine, and the West Elk Mine by agency personnel and the third-party contractor. These visits have resulted in familiarity with the existing mining, the surrounding area, and an insight regarding future mining in the region, as proposed, as well as a working understanding regarding the range of possible alternatives.

2.2 FORMULATION OF ALTERNATIVES

Alternatives were developed and analyzed to respond to the purpose for and need of the proposed actions, to address social and environmental issues, to respond to public and agency concerns and input, and to satisfy regulations of the National Environmental Policy Act (NEPA).

The interdisciplinary (ID) team of the BLM and the Forest Service met on June 17, 1999 to consider possible alternatives with regard to this EIS. A number of ideas and options were identified; some were eliminated from consideration if they clearly could not meet the proposal objectives or address the issues.

The objective of developing and reviewing alternatives for this EIS is to provide BLM and Forest Service decision-makers and the public with a range of reasonable alternatives for consideration. One of those alternatives is the No-Action Alternative, which NEPA requires to be discussed in any EIS document.

Under the action alternatives, the BLM would hold coal lease sales for the Iron Point and Elk Creek Coal Lease Tracts, subject to coal lease stipulations of the BLM and the Forest Service and any coal lease stipulations developed as part of this EIS process. Each of the action alternatives (B, C and D) by design apply coal lease stipulations. Any coal lease tract offered for competitive sale would be bound by the conditions of the standard lease form (see *Appendix H, Standard BLM Coal Lease Terms, Conditions and Stipulations*), restrictions developed from application of the unsuitability criteria (see *Appendix C, Unsuitability Analysis Report - Iron Point Coal Lease Tract (C-61209)*), and *Appendix D, Unsuitability Analysis Report - Elk Creek Coal Lease Tact (C-61357)*, and Forest Service stipulations for coal leasing (see *Appendix I, Forest*

Service Stipulations - Iron Point Coal Lease Tract (C-61209), and *Appendix J, Forest Service Stipulations - Elk Creek Coal Lease Tract (C-61357)*). The lease-by-application (LBA) process is, by law, an open, public, competitive, sealed-bid process whereupon the coal lease would be granted to the highest qualified bidder.

Following the completion of the NEPA process, and issuance of Records of Decision, if approved, the BLM would hold coal lease sales. The lessees who are successful in obtaining the coal lease tracts must provide engineering detail, along with reclamation and closure plans, designed to comply with terms, conditions, and stipulations applied to the lease as a result of the NEPA analysis to the Office of Surface Mining Reclamation and Enforcement (OSM) and the Colorado Division of Minerals and Geology (DMG). Prior to any mining activities within the lease boundaries, the detailed design, operation, and reclamation activities of the lessee(s) must meet OSM and Colorado DMG permitting regulations and guidelines. Such assurances would be required to obtain the necessary permits and approvals to conduct actual mining operations.

The BLM and the Forest Service, with input from the OSM (cooperating agency), have explored and objectively evaluated numerous project alternatives. The federal agencies used information developed during scoping to analyze potential alternatives. The objective of this discussion was to develop a reasonable array of alternatives for analysis in the Draft EIS.

As a result of this deliberation, the agencies have chosen four alternatives (No-Action plus three action alternatives) for consideration in the Draft EIS. The selection of these alternatives does not preclude the modification, addition, or deletion of an alternative in the Final EIS.

The following is a brief synopsis of the alternatives analyzed in this EIS:

- **Alternative A - No-Action Alternative.** This alternative assumes no leasing would occur and that the exploration license would be denied. In addition, this alternative presents the existing conditions in the North Fork Valley and would represent a baseline for impact analysis. It assumes a production at the Bowie No. 2 Mine of 2 million tons per year and production of 4 million tons at Oxbow's Sanborn Creek Mine. This alternative does not consider the interruption of coal production at the Sanborn Creek Mine due to the recent mine fire.

- **Alternative B - Proposed Action.** This alternative was generated based on the original coal lease applications submitted by Bowie and Oxbow. The proposed action for the Iron Point Coal Lease Tract assumes a northern boundary south of the Terror Creek Reservoir, along with an area that would provide access under Terror Creek to coal reserves to the west of Terror Creek in existing federal coal lease number C-37210. Production from the Iron Point Coal Lease Tract was assumed to be 5 million tons per year via longwall mining techniques.

  The Elk Creek Coal Lease Tract includes 40 acres added to the proposed lease tract in Section 32 (the northeast corner of the lease tract). This is acreage added to the lease tract by the BLM. Production from the Elk Creek Coal Lease Tract was assumed to range from 4 to 6 million tons per year. Coal mining would be accomplished by longwall mining techniques.

- **Alternative C - Multiple Seam Mining.** This alternative is similar to Alternative B, with the inclusion of additional reserves in the B coal seam in the Iron Point Coal

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Lease Tract, as well as additional surface area and reserves that are located between the Iron Point and Elk Creek Coal Lease Tracts. An area was also added to the Iron Point Coal Lease Tract in the Terror Creek drainage to facilitate the location of possible entries beneath Terror Creek to access coal in the Bowie No. 1 pod. These coal reserves are located in the existing federal coal lease C-37210. See *Figure 3, Historic Coal Mines and Federal Coal Lease Locations*. In Alternative C, mining would be completed by longwall techniques, and annual coal production would be the same as outlined in Alternative B.

- **Alternative D - Subsidence Protection.** This alternative would be the same as Alternative C with the limitation that there would be no subsidence under Terror Creek, Hubbard Creek, or the Curecanti-Rifle 230/345 kV electric transmission line.

Alternatives B, C, and D analyze the development of the coal lease tracts under reasonably foreseeable scenarios. These scenarios are judged by the agencies to be essentially "best estimate" mining plans which account for the competitive nature of coal leasing. It is assumed that for each lease tract, coal could be mined to the tract boundaries using longwall extraction techniques with continuous miner development and standard industry practices. See *Appendix F, Overview of Underground Coal Mining*.

For the Elk Creek Tract, it is foreseen that coal from the D seam could be extracted from a series of north-south oriented longwall panels. In the Iron Point Tract, coal from the D seam could be accessed by east-west oriented longwall panels in the southern portions of the tract, and by north-south panels in the northern portions. Alternatives C and D also consider mining the B (lower) coal seam in the Iron Point Tract. The B seam reserves could be accessed in a similar configuration as the D seam.

If another party would be the successful bidder, the BLM and the Forest Service have determined that the most probable course of action would be that the leases be accessed through existing portals. In the unlikely event that a lessee would want to construct a new and separate portal facility, a supplemental NEPA analysis would be required to determine the impacts resulting from such action. The analyses in Chapter 3 are based on assuming longwall mining and subsequent subsidence would occur.

The information and data submitted in the coal lease applications by Bowie and Oxbow do not constitute a formal underground mining permit application package (PAP) to either the OSM or the Colorado DMG. This coal lease application information has been used solely to develop an impact analysis in the EIS. Its use is intended to illustrate one possible plan for developing federal coal reserves on the lease tracts and does not imply that either Bowie or Oxbow would be given any preference in the event that lease sales are held.

Alternative B, C, and D also analyze the effects of issuing the exploration license according to a potential development scenario. *Figure 4, Iron Point Exploration Plan*, shows potential locations of exploration drill holes. The locations are estimates but are very close approximations to where the drill holes would be located. Most of the proposed locations have been visited and the potential sites located to minimize potential impacts.

The details of Alternatives A, B, C and D are set forth in the following sections. All of the action alternatives are consistent with the Grand Mesa, Uncompahgre and Gunnison Forest Plan.

Prior to initiating any work involved with any approved action alternative(s), the applicable lessee(s) must not only file and secure the necessary permits, but also must file reclamation performance securities with the Colorado DMG for any exploration or mining activities. These securities would not be released until the Colorado DMG determined that adequate closure and reclamation have been successfully completed.

2.3 ALTERNATIVE A: NO-ACTION ALTERNATIVE

NEPA requires that an EIS discuss the No-Action Alternative. This section outlines the No-Action Alternatives for the Iron Point Exploration License, the Iron Point Coal Lease Tract, and the Elk Creek Coal Lease Tract.

2.3.1 Alternative A: No-Action Alternative - Iron Point Exploration License

Under this alternative, approval for the exploration license would be denied. The No-Action Alternative would preclude any exploration in the Iron Point exploration plan area.

2.3.2 Alternative A: No-Action Alternative - Iron Point Coal Lease Tract

Under the No-Action Alternative, the Iron Point Coal Lease Tract COC-61209 would not be offered for competitive sale at this time. For purposes of this EIS analysis, the No-Action Alternative assumes that the federal mineable coal in the proposed lease area would not be mined.

If the decision would be not to lease, it would be assumed for this EIS that Bowie would continue mining its fee (private) coal reserves.

The following describes current activities for the Bowie No. 2 Mine should the No-Action Alternative be selected for the Iron Point Coal Lease Tract. This discussion would serve as a baseline against which to compare the effects of action alternatives.

Project Location. The Bowie No. 2 Mine is located approximately five miles northeast of Paonia, north of State Highway 133, and is situated at an elevation range of approximately 6,000 to 8,000 feet. See *Figure 1, General Location Map*.

Nature of Coal and Coal Reserves. Bowie is presently mining coal reserves from the D seam. The D seam ranges in thickness from 8 to 16 feet, with an average mineable thickness of ten feet. Bowie also has B seam coal reserves that could be mined from the Bowie No. 2 Mine.

The average run-of-mine coal quality for the D coal seam, on an as-received basis, follows:

BTU/pound:	12,000
Moisture:	9-10 %
Ash:	7-8%
Sulfur:	<0.5%

As of May 1999, the Bowie No. 2 Mine has approximately 5 to 6 million tons of mineable D coal within its approved permit area.

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Surface Facilities. The Bowie No. 2 Mine is an existing underground mining operation. The mine portals and major surface facilities are located about 800 feet above old State Highway 133 at an elevation of approximately 6,860 feet where the D seam subcrops. The surface facilities consist of sediment control structures, coal handling facilities, support facilities for mine operations, and other related facilities.

Coal mined from the Bowie No. 2 Mine is trucked to the Bowie No. 1 Loadout northeast of the town of Paonia, Colorado. See *Figure 1, General Location Map*. The Bowie No. 1 Loadout is an existing unit train loadout facility.

Bowie also plans to construct a conveyor belt from the existing Bowie No. 2 portal area surface facilities to a location immediately adjacent to the old State Highway 133. At this lower location, next to the old state highway, a coal storage and truck loadout area would be constructed. At this new storage facility, coal can be loaded directly into trucks and hauled to the Bowie No. 1 Loadout, thus eliminating truck use of the relatively steep and windy road from the portal pad to old State Highway 133.

Mining Techniques. Presently, room and pillar underground mining techniques are used to mine the D coal seam at the Bowie No. 2 Mine. See *Appendix F, Overview of Underground Coal Mining*, for a detailed discussion of room and pillar mining techniques. Coal is loaded from the working face by continuous miners into shuttle cars that transport coal to an underground conveyor belt loading point. This underground conveyor belt transports the coal to the surface. As part of mining, approximately two to three feet of coal is left to support the mudstones that are located immediately above the coal seam.

Bowie is proceeding with development work for the installation of a longwall system at the Bowie No. 2 Mine. It is planned that this longwall system will be installed in private coal at the operation sometime in 1999. At present, development of the initial longwall panels is being conducted at the Bowie No. 2 Mine. A detailed discussion on longwall mining techniques is set forth in *Appendix F, Overview of Underground Coal Mining*.

Operating Schedule. Bowie mining operations are presently conducted on four-ten hour production shifts (Monday-Thursday) and three-thirteen hour shifts (Friday-Sunday). Mining is conducted 365 days per year. With the installation of a longwall system, Bowie plans to maintain the same operating schedule.

Production Schedule. The Bowie No. 2 Mine is permitted with Colorado DMG to mine approximately 2 million tons of coal per year.

Area for Surface Facilities. Approximately 70 acres were disturbed for the construction of surface facilities for the Bowie No. 2 Mine. This includes the portal facilities, the haul road from the portal facilities to old State Highway 133, a utility corridor for a waterline and powerline, underground development waste rock (gob) facility, topsoil stockpile, and sediment control facilities. An estimated 10 to 15 acres will be needed for the installation of a new conveyor from the portal pad area to a location adjacent to old State Highway 133, the construction of a coal storage/truck loadout facility, and the related sediment control facilities.

Project Life. The project life of the Bowie No. 2 Mine would depend on the production rate from the operation. At a production level of 2 million tons per year from a room and pillar operation, the Bowie No. 2 Mine has approximately four to five years of D coal seam reserves.

With the installation of longwall system, the remaining D coal seam reserves provide only about one and a half years of operations without accessing the underlying B-seam.

Employment. In 1998, with room and pillar mining techniques, the Bowie No. 2 Mine employed an annual average of approximately 157 people.

Coal Transportation. At present, Bowie contracts its coal haulage to Savage Industries Inc. (Savage). Coal is being hauled in highway trucks with a capacity of approximately 28 tons of coal from the Bowie No. 2 portal area to the Bowie No. 1 Loadout.

Upon completion of the new conveyor and the coal storage and truck loadout facility adjacent to old State Highway 133, the coal haulage distance would be shortened, but Savage would continue to haul using their 28-ton trucks.

Employee/Supply Transportation. Access to the Bowie No. 2 Mine is via State Highway 133. See *Figure 1, General Location Map*.

Operational materials, consisting primarily of mine roof support materials (roof bolts and timber) fuel, and rock dust (finely-ground limestone), are delivered to the mine on a regular basis. These materials would be shipped from remote sources (Grand Junction, Salt Lake City, Denver). Listed in *Table 2-1, Materials and Supplies - Bowie No. 2 Mine* (@ 2 million tons per year), are the major consumable items for the Bowie No. 2 Mine; the table shows the estimated materials and supplies for annual production of 2 million tons of coal per year.

Table 2-1
Materials and Supplies - Bowie No. 2 Mine
(@ 2 million tons per year)

Consumables	Daily Use	Annual Use	Physical Form	Truck Shipments	
				Weekly	Yearly
Roof Bolts (tons)	4	1,500	Steel	1.25	65
Fuel (gallons)	150	55,000	Liquid	0.2	10
Rock Dust (tons)	10	4,000	Powder	3	150
Timbers	3	10,000	Crib Blocks	0.5	25

Note: These figures represent materials and supplies for room and pillar mining.

Water Use and Requirements. Water demand at the Bowie No. 2 Mine varies annually, seasonally, and even daily throughout the life of the operation. Presently Bowie has a variety of water rights including 0.5 cfs (362 acre-feet per year) from the Deer Trail Irrigation Ditch. Water withdrawals from the Deer Trail Ditch are used at the mine for varying operational needs such as surface dust control which is weather dependent. At present, the underground workings at the Bowie No. 2 Mine are essentially dry. Under normal usage, the Bowie No. 2 Mine uses approximately 59 acre-feet per year for mining purposes and approximately 6 to 7 acre-feet per year for domestic purposes.

Power Supply. -Bowie obtains its electric power from the Delta-Montrose Electric Association. Bowie has a substation located along the existing distribution/transmission line in the North Fork of the Gunnison River valley. Electricity is transmitted to the surface facilities via a powerline that has been constructed up the slope. The powerline has been designed to minimize any raptor electrocutions.

Reclamation. A discussion of reclamation appropriate to underground coal mines in Colorado is set forth in Section 2.9, Reclamation Measures.

2.3.3 Alternative A - No-Action Alternative - Elk Creek Coal Lease Tract

Under the No-Action Alternative, the Elk Creek Coal Lease Tract COC-61357 would not be offered for competitive sale at this time. For purposes of this EIS, the No-Action Alternative assumes that the federal mineable coal in the proposed lease area would not be mined.

If the decision would be not to lease, it is assumed for this EIS that Oxbow would continue its present mining of the B seam at the Sanborn Creek Mine and would still develop the Elk Creek portal area, which is located on private surface, in order to mine the D seam coal reserves from their fee (private) coal area.

The following discussion portrays the current activities of Oxbow should the No-Action Alternative be implemented for the Elk Creek Coal Lease Tract. This discussion serves as a baseline against which to compare the effects of action alternatives.

Project Location. The Sanborn Creek Mine and its related surface facilities are located immediately north and northeast of the community of Somerset, Colorado. The surface facilities are located on Oxbow's private lands north of State Highway 133, at an elevation range of approximately 6,000 to 6,100 feet. See *Figure 1, General Location Map.*

Nature of Coal and Coal Reserves. Oxbow is presently mining coal reserves from the B seam. In this area, the B seam thickness ranges up to 24 feet with an average mineable thickness of 10 to 14 feet.

The average run-of-mine coal quality for the B seam on an as-received basis is as follows:

BTU/Pound:	12,500
Moisture:	8-9%
Ash:	6-7%
Sulfur:	<0.5%

The Sanborn Creek Mine has approximately 8 to 12 million tons of mineable B seam coal within its approved permit area.

Once the B seam coal reserves are extracted from the Sanborn Creek Mine, Oxbow plans to mine D seam reserves, on its fee lands adjacent to the Elk Creek Coal Lease Tract. In this area, the B and C seams have been previously mined by U.S. Steel Corporation (see *Appendix G, Historic Coal Mining Activity*). The D seam is approximately 250 to 300 feet above the B seam.

The average run-of-mine coal quality analysis for the D seam on an as-received basis is expected to be:

BTU/Pound: 12,500
Moisture: 9-10%
Ash: 7-8%
Sulfur: <0.5%

There are approximately 4 to 5 million tons of D seam mineable coal on Oxbow's Elk Creek fee property.

Surface Facilities. The Sanborn Creek Mine is an existing mining operation. The surface facilities consist of coal handling facilities, mine support facilities, sediment control structures, and other related facilities.

Coal mined from the Sanborn Creek operation is transported via surface conveyor from the portal facility to the Oxbow coal handling and loadout facility located immediately north of the town of Somerset, Colorado. This facility includes an existing unit train loadout.

Mining Techniques. The Sanborn Creek Mine utilizes a longwall system for coal extraction. A detailed discussion on longwall mining techniques is set forth in *Appendix F, Overview of Underground Coal Mining*.

Oxbow plans to utilize the longwall mining system to complete the B seam extraction in the Sanborn Creek Mine, then relocate the longwall system to recover D seam reserves from Oxbow's fee land located adjacent to the Elk Creek Coal Lease Tract.

Operating Schedule. The Sanborn Creek Mine operates three-eight hour shifts per day, seven days per week, 356 days per year. The mine has 11 holidays.

Production Schedule. The Sanborn Creek Mine is permitted with Colorado DMG to mine approximately 4 million tons of coal per year.

Area for Surface Facilities. Approximately 95 acres are utilized for Oxbow surface facilities. This includes the coal handling, crushing, and loadout facilities located immediately north of Somerset, as well as a hooded overland conveyor system to the portals of the Sanborn Creek Mine. These facilities also include miscellaneous items such as underground development waste rock (gob) engineered fills, topsoil stockpiles, and sediment control facilities.

Oxbow plans to open a new portal facility to be called the Elk Creek portal to be located on Oxbow's private lands. The Elk Creek portal would involve a total of approximately 25 acres (including about 10 acres of existing disturbance and 15 acres of new disturbance) and would be used to support mining operations from the proposed Elk Creek portal located on Oxbow's fee surface. The other existing Oxbow facilities, including the coal handling and loadout facilities, maintenance facilities, office, bath house, and other ancillary facilities would continue to be utilized for the proposed mining through the Elk Creek portal.

Development of the Elk Creek portal on Oxbow's fee property would occur concurrently with the longwall mining in the Sanborn Creek Mine. Once mining is exhausted in the Sanborn Creek Mine, the longwall system (shear machine, longwall shields, chain conveyor, etc.), would be transported from the Sanborn Creek Mine into the Elk Creek Mine. The Elk Creek Mine would simply represent a continuation of current operations at the Sanborn Creek Mine.

Project Life. At a production rate of 4 million tons per year, the mining life of the B seam coal reserves in the Sanborn Creek Mine is approximately two to three years. Adding the D seam fee coal on Oxbow's property adjacent to the Elk Creek Coal Lease Tract, an additional two to three years of operation can be achieved.

Employment. In 1998, Oxbow had approximately 175 regular, full time employees, plus 40 contract miners, and 20 to 30 construction/contractor personnel.

Coal Transportation. Oxbow operates a unit train loadout at its existing facilities. Coal is transported from the underground operation to this unit train loadout via conveyor belt. In addition, Oxbow owns a fleet of coal hauling trucks, with a capacity of hauling 28 tons of coal per truck. These trucks are used to haul approximately 150,000 tons of coal per year to the Terror Creek Loadout, which is approximately four miles to the west of the Oxbow surface facilities at Somerset. This coal is sized for miscellaneous industrial and defense contracts, as well as for local domestic home heating uses.

Employee/Supply Transportation. Access to the Oxbow operation is via State Highway 133.

Operational materials, consisting primarily of mine roof support materials (roof bolts and timbers), fuel, and rock dust (finely-ground limestone), are delivered to the mine on a regular basis. These materials would be shipped from remote sources (Grand Junction, Salt Lake City, Denver). Listed in *Table 2-2, Materials and Supplies - Oxbow Operation (@ 4 million tons per year)*, are the major consumable items that would be required for the Oxbow mines for the annual production rate of 4 million tons of coal per year.

Table 2-2
Materials and Supplies - Oxbow Operation
(@ 4 million tons per year)

Consumables	Daily Use	Annual Use	Physical Form	Truck Shipments	
				Weekly	Yearly
Roof Bolts (tons)	4	1,100	Steel	1	50
Timbers	80	30,000	Crib Blocks	1.5	75
Fuel (gallons)	650	240,000	Liquid	1.4	70
Rock Dust (tons)	8	2,800	Powder	2	100

Water Use and Requirements. Water demand at the Oxbow operation varies annually, seasonally, and even daily during mining operations. Presently, Oxbow has two water rights totaling 0.9 cfs (652 acre-feet per year) right from the North Fork of the Gunnison River. Water withdrawals from the North Fork of the Gunnison River are used at the mine and also as a water source for the town of Somerset. Oxbow handles about 150 to 190 acre-feet per year during mining. A portion of this water is used for underground dust control; the rest is discharged to the North Fork of the Gunnison River under an approved National Pollutant Discharge Elimination System Permit. In addition, Oxbow uses approximately 6 to 7 acre-feet per year for domestic use.

Power Supply. Oxbow obtains its electric power from the Delta-Montrose Electric Association. Oxbow maintains three substations located within its surface facilities near Somerset, Colorado, and downloads electricity from an existing distribution/transmission line in the North Fork of the Gunnison River valley. A fourth substation would be added at the Elk Creek portal area.

Reclamation. A discussion of reclamation appropriate to the underground coal mines in Colorado is set forth in Section 2.9, Reclamation Measures.

2.4 ALTERNATIVE B - PROPOSED ACTIONS

2.4.1 Alternative B: Iron Point Exploration License

On May 12, 1998, an exploration license plan was submitted to the BLM in accordance with 43 CFR 3410. The exploration license area is shown on *Figure 4, Iron Point Exploration Plan*. The area encompasses approximately 6,053 acres, primarily on National Forest System lands.

Exploration licenses can be granted for the exploration of unleased federal coal deposits. Pursuant to the Mineral Leasing Act of 1920, as amended, and to 43 CFR 3410, interested parties can participate with the original applicant in a program for exploration of unleased federal coal. Any party electing to participate in an exploration license program must share all costs on a pro rata basis with the applicant and with any other party or parties who elect to participate.

On June 17, 1998, the BLM published a Notice of Invitation in the Delta County Independent in accordance with 43 CFR 3410.2-1(c)(1) describing the exploration license plan area and inviting any parties who are interested to participate in the exploration program. Ark Land Company (an affiliate of Mountain Coal Company) elected to participate in this exploration program.

The applicant proposes to drill 26 exploration holes as shown on *Figure 4, Iron Point Exploration Plan*. Holes would be rotary drilled to predetermined depths, cased as necessary, and the coal zone would be cored.

Exploration would be accomplished with one of the following methods:

- Air
- Air with water injection
- Water with synthetic polymer lubricant

Drilling would be accomplished with two types of rigs. The first, a truck mounted rotary such as a Gardner Denver 2000, and the second, a truck mounted Longyear 44 or equivalent. One mobile field office trailer, approximately 8x28 feet, would be used as a core logging facility and would be moved with the rig from location to location.

The drilling rigs would be accompanied by a 3,000-gallon water truck, a flatbed service truck, and smaller pick-up trucks as necessary for service and transportation to and from the drilling sites. A 10,000-gallon or similar water truck might be used as on-site storage to minimize the need for water trucks to travel over wet roads during inclement weather.

To further reduce water truck traffic on dirt roads, water would also be pumped to certain drill hole locations, or a central storage point, via high pressure hoses. A pump would be placed in a horse trough and located adjacent to certain stock water ponds or Hubbard Creek. The horse trough would prevent any oil, grease, or fuel from escaping to the water source. One pump site on Hubbard Creek would require helicopter transport of the pump and horse trough.

Some or all of the drill holes may be geophysically logged. The equipment necessary for such work is typically mounted in a full size Suburban-type 4x4.

To the extent possible, existing roads would be used for access and, where available, disturbed sites (wide spots, borrow pits, etc.) would be utilized for drilling sites. Some drill holes may require helicopter access. Approximately two miles of access roads may be required if all 26 holes shown on *Figure 4, Iron Point Exploration Plan*, are drilled. With these access roads, it is estimated that 2 to 3 acres would be affected. These new roads would be temporary, for drilling access only, and would be reclaimed in accordance with applicable BLM and Forest Service standards for temporary access roads and in compliance with performance standards of the Colorado DMG for light use roads. Each individual drill pad would require about 0.25 acres of surface disturbance. For 26 drill holes, an estimated 6.5 acres would be affected. In total, disturbance from exploration activities would be less than 10 acres.

Roads would be constructed using a Caterpillar D-9 class dozer, or equivalent, or smaller track-mounted dozers, and a proportionately sized backhoe such as a John Deere 410C. Most existing roads were constructed originally for coal exploration purposes, but they may require regrading, replacement of culverts, etc., for renewed drilling access use. A backhoe and/or a motor grader would be adequate to assist with this minor maintenance work.

The applicant contemplates modifying two exploration drill holes, identified as IP99-8 and IP99-10, for future groundwater monitoring wells. See *Figure 4, Iron Point Exploration Plan*.

Drilling and access road/site preparation work would begin as soon as possible after an exploration license is granted, weather permitting and in compliance with wildlife stipulations. Drilling and geophysical logging activities must occur within the two-year period allowed for under exploration license approvals.

Exploration drill hole plugging and sealing would be contemporaneous with the drilling program. When no longer needed for any drilling or geophysical logging activities, the drill sites would be reclaimed. Reclamation for exploration activities would consist of plugging and capping drill holes, recontouring drill pads, rehabilitating mud and covering sumps, redistributing topsoil, and revegetating disturbed sites with grasses and shrubs. Experience shows that drill pads reclaim within three to five years.

Exploration activities would be controlled by Forest Service surface use stipulations. See *Appendix I, Forest Service Stipulations - Iron Point Coal Lease Tract (C-61209)*.

Any exploration would also comply with the rules and regulations regarding exploration. Any surface disturbing activities associated with the exploration license area would also be subject to reclamation bonding by the appropriate agencies.

2.4.2 Alternative B - Offer Iron Point Coal Lease Tract as Applied for by Applicant

This action alternative would offer the Iron Point Coal Lease Tract for competitive leasing. The tract would contain approximately 3,403 acres of federal coal in the Iron Point Tract, with an estimated 24 million tons of recoverable D coal seam reserves. Based on the unsuitability

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criteria discussed in *Appendix C, Unsuitability Analysis Report - Iron Point Coal Lease Tract (C-61209)*, mining would be restricted or limited under the Curecanti-Rifle 230/345kV electric transmission line.

The reasonably foreseeable development scenario for the Iron Point Tract is discussed in Section 2.2, Formulation of Alternatives.

The following presents additional information regarding the Iron Point Coal Lease Tract:

Project Location. See *Figure 5, Alternative B*.

Nature of Coal and Coal Reserves. The coal reserves are in the D seam of the Mesa Verde Formation. An estimated 24 million tons of recoverable reserves are contained within this lease tract for the D seam.

Surface Facilities and Equipment. The existing surface facilities of the Bowie No. 2 Mine would be used, along with the planned construction of a new overland, covered conveyor, and a coal storage/truck loadout facility on private property. The coal storage and loadout facility would be adjacent to old State Highway 133. The lessor may establish several improvements on the lease tract, including an exhaust shaft in the Hubbard Creek drainage and degasification boreholes (one assumed for each proposed longwall panel). To the extent possible, existing roads would be used for the ventilation shaft and degasification boreholes.

Mining Techniques. Longwall mining would be planned for the lease.

Operating Schedule. Same as currently undertaken by Bowie No. 2 Mine. See Section 2.3.2 No-Action Alternative - Iron Point Coal Lease Tract (COC-61209).

Production Schedule. A projected 5 million tons of coal per year could be extracted from the lease. The actual tonnage could be less, dependant on market conditions.

Area for Additional Surface Facilities. Other than possibly three exhaust shafts and degasification boreholes, and the access to these locations, no new surface disturbance is planned. Disturbance for an individual exhaust shaft would be less than one acre. Similarly, degasification boreholes would be similar to exploration drill holes, averaging less than 0.25 acre of disturbance per site. However, depending on where the exhaust shafts and degasification boreholes are located, there could be additional disturbance associated with access road construction to the sites. Existing access roads would be used to the extent practicable.

Project Life. At 5 million tons of coal per year of production, the project life for extraction of the D coal seam from the Iron Point Coal Lease Tract would be approximately five years of operation. However, at reduced production, the project life would be extended.

Employment. An operation involving longwall mining of the coal in the Iron Point Coal Lease Tract would employ an estimated 168 people.

Coal Transportation. Coal would be transported via the newly constructed conveyor to a coal storage/truck loadout facility near old State Highway 133. These facilities are located on private ground. The coal would then be trucked to the Bowie No.1 unit train loadout.

Employee/Supply Transportation. Generally the same as Alternative A with some increases for the higher production rate. See Section 2.3.2, No-Action Alternative - Iron Point Coal Lease Tract (COC-61209) and *Table 2-3, Materials and Supplies - Bowie No. 2 Mine (@ 5 million tons per year)*..

Table 2-3
Materials and Supplies - Bowie No. 2 Mine
(@ 5 million tons per year)

Consumables	Daily Use	Annual Use	Physical Form	Truck Shipments	
				Weekly	Yearly
Roof Bolts (tons)	5	1,800	Steel	2	100
Fuel (gallons)	250	90,000	Liquid	0.25	14
Rock Dust (tons)	15	5,000	Powder	5	200
Timbers	120	40,000	Crib Blocks	2	100

Note: Numbers represent an annual production rate of 5 million tons of coal (longwall).

Water Use and Requirements. Generally the same as Alternative A. See Section 2.3.2, No-Action Alternative - Iron Point Coal Lease Tract (COC-61209). Water use for mining purposes is estimated to increase to 145 acre-feet per year as a result of the higher production.

Power Supply. Same as Alternative A. See Section 2.3.2, No-Action Alternative - Iron Point Coal Lease Tract (COC-61209).

Reclamation. Same as Alternative A. See Section 2.3.2, No-Action Alternative - Iron Point Coal Lease Tract (COC-61209).

2.4.3 Alternative B - Offer Elk Creek Coal Lease Tract as Applied for

This action alternative would offer for competitive lease approximately 3,863 acres of federal coal in the Elk Creek Coal Lease Tract, containing approximately 21 million tons of D coal seam recoverable reserves.

The mine plan presented under this reasonably foreseeable development scenario was developed from a mine plan submitted by Oxbow in their coal lease application. This plan would represent a logical extension of current Oxbow mining operations into the Elk Creek Coal Lease Tract.

This proposed action scenario is used to estimate the surface impacts of mining the coal on the Elk Creek Coal Lease Tract. This reasonably foreseeable development scenario anticipates that the Elk Creek portal would be constructed on Oxbow's Elk Creek fee lands to gain access to Oxbow's Elk Creek fee coal, followed by access to the Elk Creek Coal Lease Tract.

The following presents information regarding the Elk Creek Coal Lease Tract:

Project Location. See Figure 1, General Location Map.

Nature of Coal and Coal Reserves. An estimated 21 million tons of recoverable reserves are contained within this lease tract for the D seam.

Surface Facilities and Equipment. In order to develop the Elk Creek Coal Lease Tract, Oxbow plans to open a new portal to be called the Elk Creek Mine portal and mine their fee coal. This portal would be located on Oxbow's private lands to the south of the Elk Creek Coal Lease Tract. The existing surface facilities used for the Sanborn Creek Mine would continue in use for the Elk Creek Mine operation while mining their fee coal. These facilities would probably also be used to handle the coal mined from the Elk Creek Coal Lease Tract, regardless of the successful bidder.

There are no portals or other surface facilities to be located on the Elk Creek Coal Lease Tract. All surface facilities would be located on fee lands adjacent to the Elk Creek Coal Lease Tract, with the possible exception of a ventilation shaft in the Bear Creek drainage and 16 degasification boreholes (one assumed for each longwall panel). To the extent practicable, existing roads would be used to gain access to any future shaft and/or degasification boreholes.

Mining Techniques. Longwall mining would be planned for the lease.

Operating Schedule. Same as currently undertaken by Oxbow for the Sanborn Creek Mine. See Section 2.3.3, No-Action Alternative - Elk Creek Coal Lease Tract (COC-61357).

Production Schedule. An average of 4 million tons of coal per year and a maximum of 6 million tons of coal per year could be extracted from the Elk Creek Coal Lease Tract.

Area for Additional Surface Facilities. Disturbance for a ventilation shaft would be less than one acre. Similarly, the potential 16 degasification boreholes would be similar to exploration drill holes, averaging less than 0.25 acre of disturbance per site. These acreage figures do not include possible road access to the sites. Depending on the ability to use existing access roads, access roads might be needed to gain access to the ventilation shaft and the degasification boreholes.

Project Life. At an average of 4 million tons per year of coal production, the project life for extraction of the D coal seam from the Elk Creek Coal Lease Tract (in addition to the fee coal mined on Oxbow property) would be 8 to 12 years. At a maximum of 6 million tons per year of production, the project life for extraction of the D coal seam from the Elk Creek Coal Lease Tract alone would be between three to four years of operation.

Employment. An operation involving longwall mining of the coal in the Elk Creek Coal Lease Tract would employ an estimated 190 to 215 people.

Coal Transportation. Same as Alternative A. See Section 2.3.3, No-Action Alternative - Elk Creek Coal Lease Tract (COC-61357).

Employee/Supply Transportation. Same as Alternative A. See Section 2.3.3, No-Action Alternative - Elk Creek Coal Lease Tract (COC-61357).

Water Use and Requirements. Same as Alternative A. See Section 2.3.3, No-Action Alternative - Elk Creek Coal Lease Tract (COC-61357).

Power Supply. Same as Alternative A. See Section 2.3.3, No-Action Alternative - Elk Creek Coal Lease Tract (COC-61357).

Reclamation. Same as Alternative A. See Section 2.3.3, No-Action Alternative - Elk Creek Coal Lease Tract (COC-61357).

2.5 ALTERNATIVE C - MULTI-SEAM MINING AND ADJUSTED COAL LEASE BOUNDARIES

2.5.1 Alternative C - Iron Point Exploration License

Same as proposed for Alternative B. See Section 2.4.1, Proposed Action - Iron Point Exploration License.

2.5.2 Alternative C - Offer Iron Point Coal Lease Tract for Multi-Seam Mining

This action alternative would offer the Iron Point Coal Lease Tract for competitive leasing with both the D and B seams available for mining. The lease boundaries would be slightly widened in the area along Terror Creek to allow adequate room for underground access entries to be driven from the Iron Point Coal Lease Tract under Terror Creek to the coal in the Bowie No. 1 pod. See *Figure 6, Alternative C.*

With the expansion of the lease boundaries from those delineated for Alternative B, the Iron Point Coal Lease Tract under Alternative C would encompass approximately 3,643 acres, with an estimated 24 million tons of recoverable D coal seam reserves and an estimated 19 million tons of recoverable B coal seam reserves. As with Alternative B, any mining as contemplated under Alternative C would be restricted or limited under the Curecanti-Rifle 230/345kV electric transmission line.

The multi-seam development scenario contemplated under Alternative C would entail mining both the D and B coal seams within the Iron Point Coal Lease Tract. The B coal seam would be accessed by an underground rock slope from the overlying D coal seam. Coal mined from the B seam would be transported from the underground workings to the existing Bowie No. 2 surface coal handling and loadout facilities.

At a projected 5 million tons of coal per year of production, the project life for extraction of the D coal seam from the Iron Point Tract would be approximately five to six years of operation. At this same production rate, the extraction of the B seam would add approximately another 4 years to the life of the mine. Total project life would be an estimated nine to ten years at a production rate of 5 million tons of coal per year.

The other aspects of the mining for the Iron Point Coal Lease Tract would essentially be the same as presented for Alternative B. See Section 2.4.3, Alternative B - Offer Iron Point Coal Tract as Applied for.

2.5.3 Alternative C - Offer Elk Creek Coal Lease Tract with Revised Boundary

This action alternative would offer for competitive lease approximately 4,296 acres of federal coal in the Elk Creek Coal Lease Tract, containing approximately 23 million tons of D coal seam recoverable reserves. Under this alternative, the western boundary of the Elk Creek Coal Lease

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Tract would be adjusted to coincide with the eastern boundary of the Iron Point Coal Lease Tract. See *Figure 6, Alternative C*.

The development plans for the Elk Creek Tract would essentially be the same as presented for Alternative B; however, it might be possible to extract additional coal within the expanded western boundary area. By joining the lease tracts, access might be possible from one lease to another.

The other aspects of the reasonably foreseeable development would be the same as under that described for the Elk Creek Mine in Alternative B. See Section 2.4.3, Alternative B - Offer Elk Creek Coal Lease Tract as Applied for.

2.6 ALTERNATIVE D - NO SUBSIDENCE IN SENSITIVE AREAS

2.6.1 Alternative D - Iron Point Exploration License

Same as proposed for Alternative B. See Section 2.4.1, Proposed Action - Iron Point Exploration License.

2.6.2 Alternative D - Offer Iron Point Coal Lease Tract With Stipulation That There be No Subsidence in Sensitive Areas

This action alternative would offer the Iron Point Coal Lease Tract for competitive leasing as proposed in Alternative C. The only difference would be the strict stipulation that there would be no subsidence under either Terror Creek or Hubbard Creek, nor any subsidence under the Curecanti-Rifle 230/345 kV electric transmission line.

2.6.3 Alternative D - Offer Elk Creek Coal Lease Tract With Stipulation That There be No Subsidence in Sensitive Areas

This action alternative would offer the Elk Creek Coal Lease Tract for competitive leasing as proposed in Alternative C. The only difference would be the strict stipulation that there would be no subsidence under Hubbard Creek.

2.7 TRANSPORTATION OPTIONS

Transportation attracted considerable attention and comments during the scoping period. In particular, there were two main issues:

1. Coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout; and,

2. The impacts of increased railroad traffic and the ability of the Union Pacific Railroad to handle increased coal tonnage from the mines in the North Fork of the Gunnison River valley.

Possible options to coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout include the following:

- No-Action Alternative (not lease the Iron Point Coal Lease Tract)
- Limited production on Iron Point Coal Lease Tract

- Increase capacity of highway trucks hauling the coal
- Build a new railroad loadout at Bowie No. 2 Mine to replace the Bowie No. 1 Loadout
- Build a stand-alone haul road from Bowie No. 2 Mine to the Bowie No. 1 Loadout and utilize off-highway haulers
- Build a conveyor from Bowie No. 2 Mine to the Bowie No. 1 Loadout

Railroad options would include an examination of the No-Action Alternative and the impacts of relative levels of total coal production shipped by rail from the North Fork of the Gunnison River valley.

In response to public input and public interest, the BLM and Forest Service decided to examine these transportation options in Section 3.14, Transportation. The BLM and the Forest Service recognize that these transportation options exist with differing economic and legal implications. The lead agencies decided that it was in the public interest to discuss these options and the various impacts/benefits that might occur with the implementation of such options.

During the scoping process, representatives from the Colorado Department of Transportation did not indicate any problem with State Highway 133 handling the projected increased coal truck traffic. In addition, a representative from the Union Pacific Railroad also voiced his opinion that the existing railroad can handle increased coal tonnage from the mines in the North Fork Valley.

2.8 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED EVALUATION

2.8.1 Offer Iron Point and Elk Creek Coal Lease Tracts Without Stipulations

This alternative would not include any standard and/or special coal lease stipulations for the protection of non-coal resources such as wildlife, soils, water, etc. This alternative was not analyzed because it would be inconsistent with BLM and Forest Service land-use plans. Environmental impacts resulting from this alternative could cause material damage of resources.

2.8.2 Room and Pillar Mining (no Longwall Mining) of the Iron Point and Elk Creek Coal Lease Tracts

The impacts of room and pillar mining were not assessed for the Iron Point or Elk Creek Coal Lease Tracts. This alternative was considered but not analyzed given the current reasonable expectation that the coal in both leases would be recovered by longwall mining techniques, as this mining method seems to be the trend for mining in the North Fork of the Gunnison River valley. If a successful lessee decides that mining should be completed solely by room and pillar methods, it might be necessary to undertake additional environmental analysis to determine mining impacts, especially the subsidence potential, which would be different than longwall-induced subsidence.

2.8.3 Surface Mining of the Iron Point and Elk Creek Coal Lease Tracts

Surface mining of the coal in the Iron Point and Elk Creek Coal Lease Tracts would neither be economically or environmentally preferable due to topographic and geologic conditions.

2.8.4 Limit the Size of the Iron Point Coal Lease Tract to Avoid Coal Beneath Terror Creek and Curecanti-Rifle 230/345kV Electric Transmission Line

An alternative, discussed in the environmental assessment (EA) prepared for the Iron Point Coal Lease Tract, would have adjusted the lease boundaries to eliminate area from the lease under Terror Creek and the Curecanti-Rifle 230/345 kV electric transmission line, as well as adding a one mile buffer zone from the Terror Creek Reservoir. The purpose of these restrictions was to prevent any subsidence from impacting these facilities.

In limiting the size of the Iron Point Coal Lease Tract, and precluding any mining access beneath Terror Creek, access to the coal reserves in Federal Coal Lease COC-37210 could be realized only via the existing Bowie No. 1 Mine or by re-opening and rehabilitating the now abandoned Farmer's Mine. It should be noted that such actions would only be speculative at this point, as no formal permit applications or requests for such actions have been submitted to the Colorado DMG or other regulatory agencies.

Accessing the federal coal reserves in Lease COC-37210 through the existing Bowie No.1 Mine would be expensive and also extremely difficult given the dangers and hazards that such an undertaking might involve rehabilitating through the area in the mine ravaged by a 1986 mine fire. Perhaps, such a rehabilitation would not be allowed by the Mine Safety and Health Administration.

Re-opening and rehabilitation of the old Farmer's Mine would have its own set of impacts and expenses. A new portal area with its associated surface facilities would have to be constructed. The access roads to the site would have to be upgraded. Travel and coal transportation in the Garvin Mesa area would be increased dramatically, causing safety, dust and noise impacts to area residents.

This alternative of reducing the size of the Iron Point Coal Lease Tract was eliminated from detailed evaluation. The action alternatives will effectively address the relevant issues.

2.9 RECLAMATION MEASURES

Regulations and policies of the BLM, Forest Service, OSM, and Colorado DMG require reclamation. Areas disturbed by coal exploration and mining operations in the state of Colorado must be returned to a stabilized and productive condition following the exploration and mining. The goal of reclamation is to protect long-term land, water, and air resources in the area. Lands disturbed by coal exploration and mining operations must be returned to productive land uses consistent with land management policies.

Any coal exploration and mining activities within the state of Colorado must receive approval of reclamation measures from the Colorado DMG. Similarly, for coal exploration and mining activities on federal lands administered either by the BLM or the Forest Service, reclamation plans for any disturbed sites must be submitted to and approved by the BLM and/or Forest Service. The OSM, a federal agency with oversight on coal exploration and mining, provides oversight of the Colorado DMG and cooperates with the BLM and Forest Service when federal coal is involved in either exploration or mining. Specific reclamation plans are part of the PAP submitted to Colorado DMG.

Any reclamation plans approved for the Iron Point exploration tract and for mining on or associated with the Iron Point or Elk Creek Coal Lease Tracts would be required to describe measures to reduce long-term impacts at the disturbed sites, with the goal to return any disturbed land to a productive state similar to that which existed on the site prior to exploration or mining disturbance.

It should be noted that reclamation practices and technology are changing and developing. There could be future modifications in reclamation plans as techniques and materials are refined or developed. Any applicant for an exploration license or lessee of a federal coal tract would certainly be encouraged to take advantage of opportunities to explore new reclamation techniques and new methods for erosion control. Reclamation plans for coal mining operations are reviewed every two and a half years and would be updated at least once every five years or as appropriate to include improvements in reclamation technology.

Any reclamation programs for the Iron Point Exploration License Area and the Iron Point and Elk Creek Coal Lease Tracts would be designed to reclaim exploration and/or mine related disturbance in compliance with the requirements of the applicable regulatory agencies.

2.9.1 Reclamation Goals and Objectives

The current land use of the Iron Point Exploration License Area and the Iron Point and Elk Creek Coal Lease Tracts is primarily livestock grazing, wildlife habitat, and dispersed recreation. Some of the area in the general vicinity of the exploration license and coal lease tracts has previously been harvested for timber (aspen).

The reclamation plan for any disturbances associated with any of the alternatives would incorporate the following basic goals:

- Establishment of stable surface, topographic, and drainage conditions that are compatible with the surrounding landscape and that control erosion, water quality, and air quality impacts;

- Establishment of surface soil conditions that are conducive to regeneration of a stable plant community through removal, stockpiling, and re-application of suitable topsoil and cover soil material;

- Revegetation of disturbed areas using species adapted to site conditions in order to establish a long-term productive, self-sustaining, biotic community compatible with currently identified land uses and comparable with what currently exists on the site; and,

- Consideration of public safety including posting warning signs, limiting public access, and stabilizing or removing structures created as a result of mining activities that could constitute a public hazard.

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2.9.2 Reclamation Schedule

Closure and reclamation measures would be incorporated into exploration and mine permits, and they would be an integral part of any exploration and mining by the BLM, Forest Service, OSM, and the Colorado DMG.

Reclamation activities would be initiated as soon as reasonably feasible following completion of any exploration or mining related disturbance in a particular area if the area is not going to be used for some ongoing or proposed future operation. One of the fundamental objectives of reclamation is to minimize erosion and sedimentation problems. In general, reclamation activities would be timed to take advantage of optimal climatic conditions. Seed beds would be prepared, and seeding would be completed in order to take advantage of seasonal moisture.

Interim reclamation would be employed to reduce erosion and the potential for water quality degradation. Interim reclamation refers to reclamation efforts on lands disturbed during the course of a project. It is used to temporarily stabilize an area prior to final reclamation. Interim reclamation would include revegetation to reduce erosion and sedimentation during the life of a project. Topsoil would not be applied to interim revegetation areas. Mulch would be applied, as appropriate, following seeding. The areas which would require interim reclamation would include temporary road embankments and topsoil stockpiles.

Most reclamation activities for an exploration project and underground mining operation would occur on completion of the use of an exploration drill hole site and at final mine closure and would be considered permanent, or final, reclamation. The areas to undergo reclamation at the completion of an exploration program would include drill pads and roads not needed for some future ongoing use. For mine closure, reclamation would involve the portal facility areas, coal waste rock disposal areas, borrow sites, roads, and other ancillary areas. Final reclamation for an underground coal operation would begin upon permanent cessation of mining activities for the associated coal reserve area.

Temporary Cessation. Although a temporary cessation of operations is generally not planned, circumstances beyond the control of applicants may require temporary cessation of operations at either mine site. Cyclical production trends or slow-downs are unpredictable because they are due to a combination of circumstances including expiration of coal contracts, fluctuation in coal prices, labor disputes or costs, production costs, taxes, company profitability, and effects of national, political and economic events.

In the event of a temporary cessation of coal mining activities, mine operators would notify the BLM, Forest Service, OSM, and Colorado DMG of the temporary curtailment of mining activities. This notification would include reasons for the shutdown and estimated time frame for resuming production, as well as ongoing maintenance and monitoring measures to be employed during the temporary cessation of operations. As an example, the Bowie No. 1 Mine is currently in temporary cessation.

During any temporary shutdown, operational and environmental maintenance activities would continue to assure the site meets all permit and lease stipulations and requirements for environmental protection. Environmental monitoring requirements would continue on defined schedules, as outlined in lease stipulations and appropriate permit approvals. Environmental reports would be submitted in a timely manner. Regardless of the operating status of the mining, appropriate monitoring would be continued until compliance with all permanent closure requirements was attained, unless modified by the appropriate regulatory authorities.

Permanent Cessation. In the unlikely event that mining activities permanently cease prior to the scheduled completion of operations, environmental impacts related to such operations may be less than originally envisioned, although socioeconomic impacts may be magnified. If operations cease prematurely, the mine operators would work with the appropriate agencies, as necessary, to revise the reclamation plan in order to specifically address the existing conditions at the time of closure.

2.9.3 General Reclamation Practices

Coal exploration and mining operators are responsible for the following general steps in reclaiming disturbed areas:

- Decommissioning of facilities
- Removal of structures
- Portal closing and sealing
- Sealing and plugging drill holes
- Recontouring and regrading
- Topsoil replacement
- Topsoil sampling and fertilization
- Permanent revegetation
- Mulching
- Reclamation maintenance and monitoring

Each of these steps is described in the following sections.

Decommissioning of Facilities. Unless a beneficial alternative post-mining land use is approved, following completion of an exploration project and the permanent cessation of a coal mining operation, all equipment, instrumentation, furniture, etc. would be removed from the site or disposed of in a manner acceptable to and approved by the Colorado DMG.

Removal of Structures. Unless a beneficial alternative post-mining land use is approved, all structures and facilities used for exploration or mining activities would be dismantled and/or removed from the site at the time of project completion or permanent operation closure. This includes temporary trailers, the portal facility complex, the coal handling and loadout facilities, electric power facilities such as powerlines and substations, shops, warehouses, office buildings, etc.

Portal Closing and Sealing. At the permanent cessation of underground coal mining activities, all portal entries and ventilation raises or shafts would be permanently sealed. Permanent closure measures would be designed and implemented to prevent access to the mine workings by people, livestock, fish and wildlife, machinery, and to keep possible or potential acid or other toxic drainage from entering ground and/or surface waters.

Sealing and Plugging Drill Holes. Exploration holes, drill holes, boreholes, and wells not completed to aquifers would be sealed by replacing cuttings in the hole and placing a suitable plug ten feet below the ground surface to support a cement plug to within three feet of ground surface, unless otherwise authorized by the land managing agency and/or the Colorado DMG.

Exploration holes, drill holes or boreholes, or wells completed in aquifers would be sealed using bentonite, cement or other suitable sealant, by placing the sealant in the hole from the bottom to within ten feet of the ground surface. Final sealing of the hole would be accomplished as stated in the first paragraph of this section.

Recontouring and Regrading. The portal facility areas and other disturbed areas would be recontoured and regraded as appropriate to achieve an acceptable post-mining topography. During this phase of project closure, high traffic areas such as roads would be ripped to alleviate compaction. Post-mining surface drainage patterns would be re-established.

Topsoil Replacement. Following regrading activities, disturbed sites would be covered with topsoil material or suitable substitute. Such topsoil or other suitable material would be replaced to serve as a rooting zone for revegetation. Soil amendments would be incorporated, as needed, to aid in revegetation.

All sites would be stabilized to maintain safe working conditions by regrading along the contour, applying topsoil material along the contour, and/or leaving the regraded surface in a roughened configuration to resist wind, water erosion and maximize soil water retention. Surface manipulation treatments such as ripping and chiseling along the contour, contour furrows, and/or contour terraces would be employed and/or constructed in areas likely to develop rills and gullies and in heavily compacted areas.

Permanent Revegetation. Reseeding would be conducted on disturbed sites with a seed mixture used for permanent revegetation. Reseeding would be conducted by appropriate application methods such as broadcast-seeding, drill-seeding, or hydro-seeding.

Mulching. As required for initial stabilization, erosion control materials such as wood fiber mulch, straw, or erosion control/mulch blankets would be applied in a separate step following seeding. Such mulching practices would be employed as necessary to reduce initial erosion and sedimentation.

Reclamation Maintenance and Monitoring. Newly reclaimed areas would be managed consistent with reclamation goals. The sites would be examined periodically during the first several years after revegetation to determine the effectiveness of the reclamation program. The success of revegetation would be monitored to ensure erosion was prevented and that species re-establishment was occurring. Maintenance would be conducted on the site as necessary to assure site stability and the establishment of the preferred plant species.

2.9.4 Reclamation Performance Securities

The statutory and regulatory authority of the BLM, Forest Service, OSM, and the Colorado DMG requires the submittal of reclamation performance securities (bonds) to assure that adequate reclamation and restoration of disturbed areas are achieved following exploration and mining activities. The bond would assure that sufficient monies are available to properly reclaim areas disturbed and/or to conduct monitoring or other activities in the event that the exploration or mine operator was unable to meet their reclamation obligations. A bond is a financial guarantee that would be forfeited to the appropriate agency should the operator abandon the site and fail to properly reclaim the site. A bond would provide the agency with sufficient funds to complete the necessary reclamation.

No exploration or mining operations can commence without the execution of a reclamation bond with the applicable agencies responsible for reclamation of the sites.

2.10 MANAGEMENT AND MITIGATION

Existing federal and state rules and regulations require extensive mitigation and monitoring to mitigate the environmental consequences associated with coal exploration or mine operation.

Management and mitigation practices are based on federal, state, and local laws and regulations, current technology, and best management practices. The objectives of these management and mitigation practices would be to reduce or avoid adverse impacts to the environment and to reclaim disturbed areas. Implementation of management and mitigation measures would primarily be the responsibility of the exploration proponents or mine operators. Enforcement of management and mitigation measures would be within the jurisdiction of the governmental agencies issuing permits and approvals for such coal exploration or mining activities.

Mitigation measures are either required or proposed in the BLM Unsuitability Criteria Analysis, the Forest Service Standard Stipulations, or Chapter 3, Environmental Analysis.. Depending on one's perception and resource capabilities, all measures would have a moderate to high degree of effectiveness in mitigating impacts. Final mine plans submitted for mine permit approval will be designed and reviewed to ensure they address site specific requirements and conditions and thereby increase the effectiveness of the mitigation measures.

2.11 MONITORING MEASURES

Environmental monitoring programs that meet the requirements of the BLM, Forest Service, OSM, and the Colorado DMG would be implemented and maintained as part of mining activities. Monitoring would determine the effects of the mining and the efficiency of mitigation measures. Monitoring would also provide valuable input to governmental agencies regarding project performance. The information gained during monitoring would be used as the basis for designing additional mitigation measures, if necessary. The effects analyses in Chapter 3 incorporate the monitoring that will be required for a mine permit, if the leases are issued (see Section 2.10, Management and Mitigation).

2.12 COMPARISON OF ALTERNATIVES

This section summarizes the impacts of the alternatives. Environmental consequences of each alternative are addressed in Chapter 3, Environmental Analysis. *Table 2-4, Summary of Impacts by Alternative for Each Issue*, compares alternatives to the issues that drove alternative development, as well as those issues identified as being important to assess the impacts of the alternatives. Issues are identified in Section 1.8, Issues and Concerns, in Chapter 1, Purpose and Need for Action.

2.13 PREFERRED ALTERNATIVE

The preferred alternative is best described as a combination of Alternative B and D. A more detailed discussion of the preferred alternative is given in the Executive Summary.

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Table 2-4
Summary of Impacts by Alternative for Each Issue

Issue/Concern	Alternative			
	A	B	C	D
AIR QUALITY				
Effects from Fugitive Dust	None	Low	Low	Low
Effects from Gaseous Emissions	None	Low	Low	Low
Visibility Effects on West Elk Wilderness Area	None	Low	Low	Low
Visibility Effects on Black Canyon of the Gunnison	None	Negligible	Negligible	Negligible
AQUATIC RESOURCES/FISHERIES				
Direct Disturbance to Stream Channels	None	High	High	Low
Reduced Flow	None	Moderate	Moderate	Low
Stream Sedimentation	None	Moderate	Moderate	Low
Water Quality Degradation	None	Low	Low	Low
Impacts to Threatened and Endangered Aquatic Species	None	Negligible	Negligible	Negligible
CULTURAL RESOURCES				
Impact to Cultural and Historic Sites	None	None	None	None
GEOLOGY/SUBSIDENCE				
Potential Effect to Curecanti-Rifle 230/345 kV Electric Transmission Line	None	None	None	None
Potential Effect to Terror Creek Reservoir	None	Low	Low	Negligible
Potential Effect to Terror Creek	None	High	High	Negligible
Potential Effect to Hubbard Creek	None	High	High	Negligible
Potential to Aggravate Landslides	None	Low	Low	Low
Land Use				
Acres Disturbed (total)	Not Applicable	33.5	33.5	33.5
Land Disturbed by Ownership (%)	Not Applicable			
• BLM		26	27	27
• Forest Service		59	62	62
• Private		15	11	11
Noise				
Noise Effects	Low	Moderate	Moderate	Moderate

Table 2-4
Summary of Impacts by Alternative for Each Issue

Issue/Concern	Alternative			
	A	B	C	D
Recreation				
Disruption to Recreational Opportunities in Undeveloped Areas	Not Applicable	Negligible	Negligible	Negligible
Changes in Recreational Access to Undeveloped Areas	Not Applicable	Negligible	Negligible	Negligible
Socioeconomics				
Projected Total Life of Mining ▸ Iron Point Tract ▸ Elk Creek Tract	 1.5* 3*	 5 5	 8 6	 7.5 6
* Remaining permitted life of Bowie No. 2 and Sanborn Creek mines under No-Action Alternative.				
Annual Employment During Mining ▸ Iron Point Tract ▸ Elk Creek Tract	 157** 215**	 168 215	 168 215	 168 215
** Current employment levels at Bowie No. 2 and Sanborn Creek mines.				
Projected Multi-Year Tax Revenues for Mining of Iron Point and Elk Creek Tracts (direct + indirect)	0	$88,500,000	$123,900,00	$119,475,000
Projected Federal Coal Royalties From Mining Iron Point and Elk Creek Tracts	0	$35,500,000	$46,900,000	$45,225,000
Surface and Groundwater				
Changes in Surface and Groundwater Chemistry	Not Applicable	Low	Low	Low
Potential Impact to Terror Creek Reservoir	None	Low	Low	Negligible
Potential to Alter Downstream Flow Rates	None	Moderate	Moderate	Low
Transportation				
Average Number of Round Trips per Day for North Fork Branch Railroad (Cumulative)	4.4 @ 8.6 million tons per year	10 @ 19.2 million tons per year	10 @ 19.2 million tons per year	10 @ 19.2 million tons per year
Average Number of Round trips per Day for Coal Truck haulage Between Bowie No. 2 Mine and Bowie No. 1 Loadout	234 @ 1.2 million tons per year production	978 @ 5 million tons per year production	978 @ 5 million tons per year production	978 @ 5 million tons per year production
Potential for Accidents at Railroad Crossings	Very Low	Low	Low	Low

Table 2-4
Summary of Impacts by Alternative for Each Issue

Issue/Concern	Alternative			
	A	B	C	D
Potential for Accidents on State Highway 133 Due to Coal Truck Haulage	Very Low	Low	Low	Low
Potential for Accidents on State Highway by Using Private Haul Road, Conveyor or by Moving Bowie No. 1 Loadout	Very Low	Low	Low	Very Low
Vegetation				
Number of Threatened and Endangered Plants Lost	Not Applicable	0	0	0
Potential Impact of Noxious Weeds	Not Applicable	Low	Low	Low
Potential Impact to Sensitive Plants	Not Applicable	Low to Moderate	Low to Moderate	Negligible
Wetlands				
Potential to Impact Wetlands/Riparian Zones ▸ Terror Creek ▸ Hubbard Creek	 None None	 Moderate Moderate	 Moderate Moderate	 Negligible Negligible
Wildlife (Terrestrial)				
Impacts to Threatened and Endangered Terrestrial Wildlife Species	None	Low	Low	Very Low
Impacts to Deer/Elk Habitat	None	Negligible	Negligible	Negligible

Chapter 3

Environmental Analysis

3.0 ENVIRONMENTAL ANALYSIS

This chapter of the Environmental Impact Statement (EIS) describes both the existing conditions of and the environmental consequences to the area and resources, based on the alternatives described in Chapter 2. For ease of presentation and comparison, the analysis discussions are separated into individual resource areas, such as air quality, geology, noise, wildlife, etc. Although the anticipated environmental effects of alternatives were analyzed for each resource discipline, impact analyses emphasize those disciplines that relate to the key issues and concerns identified in Chapter 1, Purpose and Need for Action. Some impacts are expressed in qualitative terms, other in quantitative terms.

Impact descriptions under each resource area are divided into the following categories:

- Effects Common to All Action Alternatives;
- Effects of the No-Action Alternative; and
- Effects Unique to Each Action Alternative.

Impacts are defined as follows:

- **Direct Impacts** - Those effects which occur at the same time and in the same general location as the activity causing the effects.

- **Indirect Impacts** - Those effects which occur at a different time or different location than the activity to which the affects are related.

- **Cumulative Impacts** - Those effects which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions.

- **Irreversible Commitments** - Those commitments that can not be reversed, except perhaps in the extreme long term.

- **Irretrievable Commitments** - Those commitments that are lost for a period of time.

The effects analyses in Chapter 3 are based on reasonably foreseeable development scenarios discussed in Section 2.2, Formulation of Alternatives, for the lease tracts and the exploration license area. For the lease tracts, potential effects consider impacts related to subsidence as presented in *Appendix K, Subsidence Evaluation*. The subsidence evaluation was completed assuming "best estimate" mining scenarios (reasonably foreseeable development).

Mitigation measures to be implemented for any exploration or mining activity are addressed in Chapter 2, Alternatives Including the Proposed Action. By design, each alternative has built-in mitigation in the form of standard and special stipulations that would be added to any lease or license. Effective mitigation avoids, minimizes, rectifies, reduces, or compensates for potential impacts. After mitigation is applied, any unavoidable adverse impacts to each resource area are addressed. Based on the impact analysis for the individual resource areas with this Chapter 3, additional mitigation measures are listed which could further reduce environmental impacts should exploration and mining be conducted.

3.1 AIR QUALITY/CLIMATE

***Issue:** Identify and minimize air quality impacts. Areas of concern include: the effects on air quality from fugitive dust and gaseous emissions; air quality impacts (visibility on the West Elk Wilderness Area, and cumulative air quality effects.*

3.1.1 Introduction

This section describes the following items related to air quality:

- Regional climate and existing air quality;
- Air quality regulations that apply to the mining operations and railroad;
- Industrial operations conducted by Bowie and Oxbow that are permitted by the Colorado Air Pollution Control Division (APCD);
- Project-related emission rates from mining activities, haul trucks, diesel mine equipment, trains, and public vehicles traveling through the project area along State Highway 133;
- Ambient air quality impacts adjacent to the existing mine sites;
- Health effects and odor impacts at areas near the mining operations and along the railroad tracks;
- Air quality impacts to the nearby West Elk Wilderness Area; and
- Greenhouse gases emitted by the mining operations.

3.1.2 Affected Environment and Air Quality Regulations

3.1.2.1 Regional Climate

Temperature and precipitation data for the Paonia area are listed in *Table 3.1-1, Temperature and Precipitation Data for Paonia, Colorado*. Precipitation amounts are generally believed to increase to the east. The mountain valleys on the western side of the Rockies are subject to large ranges in precipitation and temperature conditions. Low precipitation amounts are normal during all seasons. Low summer precipitation, along with high temperatures and low humidity produce conditions favorable for wind erosion. Summertime rain is often associated with passing thunderstorms. Temperatures above 100°F are infrequent. Prolonged cold conditions are common in the mountain valleys, and result when cold dense air fills the valleys.

Annual wind distributions at Somerset (for the West Elk Mine monitoring station) are presented as an annual wind rose in *Figure 8, Wind Rose for West Elk Mine*. This wind rose depicts the joint frequency of occurrence, in percentage, of wind speed and wind direction categories for a particular location and time period. The radials of the wind rose indicate the direction from which the wind is blowing. The length of the radials indicates the frequency of occurrence for that direction, and the width of the radials indicates the wind speed class.

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Table 3.1-1
Temperature and Precipitation Data for Paonia, Colorado

Month	Precipitation (in)	Temperature (°F)
January	1.08	24.9
February	1.03	31.6
March	1.38	39.3
April	1.28	47.4
May	1.34	56.8
June	0.84	66.1
July	1.14	72.6
August	1.21	70.5
September	1.48	62.0
October	1.61	51.3
November	1.36	38.7
December	1.42	28.2
Annual	15.17	49.1
Data Source:	National Climatic Data Center Period of Record: 1976 through 1998	

The wind rose shown in *Figure 8, Wind Rose for West Elk Mine*, displays a wind pattern that is common for a narrow river valley. Strong persistent winds blow along the valley, and weak infrequent winds blow across the valley. The prevailing winds blew up-valley or down-valley with a high wind speed (3.8 meters/second average). Cross-valley winds blowing southward toward the West Elk Wilderness were infrequent (less than 2% frequency of occurrence) with a low speed (2.5 meters per second). The average wind speed for all directions was 3.6 meters per second.

3.1.2.2 Ambient Air Quality Standards

The Federal Clean Air Act required the U.S. Environmental Protection Agency (EPA) to set ambient air quality standards (AAQS) to protect the public health and welfare. Standards to protect public health (primary standards) were developed to protect the most sensitive individuals and allow a margin of safety. When a health-based primary standard does not protect public property or resources (for example, ensuring that dust concentrations are low enough to prevent damage to crops or soiling of buildings), a secondary standard was established which is more restrictive than the primary standard.

Applicable AAQS are listed in *Table 3.1-2, Ambient Air Quality Standards*. Air quality standards have been established for carbon monoxide (CO), lead (Pb), particulate matter with aerodynamic diameters less than 10 micrometers (PM_{10}), nitrogen dioxide (NO_2), ozone (O_3), and sulfur dioxide (SO_2).

Table 3.1-2
Ambient Air Quality Standards

Pollutant	National		Colorado
	Primary	Secondary	
Proposed Fine Particulate Matter ($PM_{2.5}$) ($\mu g/m^3$)			
Annual arithmetic average	15	15	15
24-hour average	65	65	65
Fine Particulate Matter ($PM_{2.5}$) ($\mu g/m^3$)			
Annual arithmetic average[1]	50	50	50
24-hour average	150	150	150
Carbon Monoxide (ppm)			
8-hour average	9	9	10
1-hour average[2]	35	35	40
Ozone (ppm)			
8-hour average	0.08	0.08	0.08
1-hour average	0.12	0.12	0.12
Sulfur Dioxide (ppm)			
Annual average	0.03	0.02	0.006
24-hour average	0.14		0.038
3-hour average		0.05	0.267
Lead ($\mu g/m^3$)			
Calendar quarter average	1.5		1.5
Nitrogen Dioxide (ppm)			
Annual Average	0.053	0.053	0.05

Source: 40 CFR Part 50
Notes: ppm = parts per million
($\mu g/m^3$) = micrograms per cubic meter
Annual standards never to be exceeded, shorter-term standards not to be exceeded more than once per year unless noted.

- Standard attained when expected number of days per year with a 24-hour concentration above 150 $\mu g/m^3$ is less than or equal to one.
- Standard attained when expected number of days per year with an hourly average above 0.12 ppm is less than or equal to one.

Primary and secondary standards have been established for particulate matter that can be respired by humans. A number of published studies suggest that premature mortality, hospital admissions, and respiratory illnesses occur at concentrations below the PM_{10} standards. In 1997, EPA revised the particulate matter standards by adopting new standards for particles smaller than 2.5 micrometers (PM_{10}). The PM_{10} standards are currently under development, and do not yet apply to any facilities.

3.1.2.3 Regional Air Quality

The air quality in Delta and Gunnison counties is generally god and achieves all state and national AAQS, based on information from the nearest air pollution monitoring stations. The second highest 24-hour and annual average PM$_{10}$ concentrations measured at Delta, Colorado for 1993 through 1998 are presented in *Table 3.1-3, Ambient PM$_{10}$ Concentrations at Delta, Colorado*. The monitoring station is located in Delta which is more densely populated than the Paonia/Somerset area, and monitoring data from Delta may not be representative of air quality at Paonia. Windblown dust and wood stoves are believed to be the most prevalent air pollutant emission sources in the region, so the state operates monitors for only PM$_{10}$ in Delta and Gunnison counties.

Table 3.1-3
Ambient PM$_{10}$ Concentrations in Delta, Colorado

Year	PM$_{10}$ Concentration ($\mu g/m^3$)	
	Second Highest 24-hour	Annual Average
1993	70	29.5
1994	69	31.5
1995	67	24.4
1996	No Data	25.6
1997	55	23.1
1998	40	22.8

Average visibility in Delta and Gunnison counties is typically about 100 miles with greatest visibility occurring during spring and summer months. The Paonia-Somerset area of the North Fork of the Gunnison River has been designated as a Prevention of Significant Deterioration (PSD) Class II area. PSD Class II areas are those that may be developed, and the release of limited concentrations of certain pollutants over Class II PSD increments is permitted as long as AAQS is maintained and emissions are within the PSD Class II increment. The nearest PSD Class I area (an area where little air quality deterioration is allowed) is the West Elk Wilderness, located approximately 10 miles south-southeast of the Somerset area. Another PSD Class I area in the region is the Black Canyon of the Gunnison National Monument, located approximately 26 miles to the southwest of the Somerset area.

3.1.2.4 Air Permitting Requirements for Industrial Sources

All industrial sources in Colorado must receive an Air Pollution Emission Notice (APEN) permit from the Colorado Department of Public Health and Environment, APCD before they begin to construct any new processes or expand any existing processes. The APEN permit specifies the following requirements:

- Type of equipment that is permitted to be installed;
- Type of pollution control equipment that is required;
- The types of emission monitoring and testing that are required;

- Allowable production rate; and
- Allowable emission rates.

The Bowie and Oxbow mining operations near Paonia have either applied for or already received their APEN permits to expand their coal production rates to the values specified in Chapter 2, Alternatives Including the Proposed Actions.

3.1.2.5 Prevention of Significant Deterioration Permitting (Not Required for Bowie Resources or Oxbow Mining)

Colorado APCD imposes stringent requirements for large industrial sources under the PSD program. PSD permitting applies only to industrial facilities that emit more than 250 tons per year of PM_{10}, NO_x, or SO_2 from stationary, non-fugitive dust sources.

None of the coal mining facilities in the North Fork of the Gunnison River area are subject to PSD permitting, because none of them generate enough non-fugitive emissions to trigger PSD.

3.1.2.6 Federal Emission Standards for Locomotives and Non-Road Diesel Engines

EPA has enacted regulations that will require diesel locomotives and large diesel mine equipment to reduce their emissions. The required improvements are designed to reduce the emissions of NO_x by about 33 percent. The retrofits are not required immediately. Instead, the regulations require modifications to the locomotives when they are next refurbished after their normal operating life cycle (approximately 750,000 miles of operation). The impact assessments for this EIS were completed assuming that no diesel locomotives have been modified to meet the new emission standards.

3.1.3 Environmental Consequences

3.1.3.1 Summary

The air quality impacts are summarized as follows:

- Due to anticipated increased coal production from the coal mines in the North Fork of the Gunnison River area, emissions from regional mining operations and coal trains are expected to increase for the "No-Action" and "Action" alternatives.

- The action alternatives would increase local emissions of particulate matter and tailpipe exhaust by about 7 to 8 percent compared to the No-Action Alternative.

- All of the regional mines are regulated by the Colorado APCD. Particulate emissions from the mines are minimized by use of conventional air pollution control equipment.

- Based on air dispersion modeling, it is concluded that dust emissions from the mines do not cause any ambient air quality impacts.

- Based on computer modeling, it is concluded that the incremental increases in particulate emissions and gaseous emissions resulting from the action alternatives would not cause any consequential acid deposition or visibility impacts at the nearby West Elk Wilderness Area.

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3.1.3.2 Effects of Alternative A (No-Action)

Under the No-Action Alternative, the three local mines are assumed to operate at the following production rates:

Bowie No. 2 Mine	2 million tons per year
Oxbow Mining	5 million tons per year
Mountain Coal, West Elk Mine	8.2 million tons per year
Combined Production	15.2 million tons per year

The estimated emissions for this alternative are listed in the following tables:

- *Table 3.1-4, Summary of PM_{10} Emissions from Local Mines*
- *Table 3.1-5, Tailpipe Emissions for No Action Including Cumulative Impacts*

For this alternative the following air quality impacts would occur:

Increased Mine Emissions. Particulate emissions from the Bowie, Oxbow and West Elk mines would increase by a combined 131 tons per year compared to levels in the year 1998. The mines are regulated by Colorado APCD, so ambient PM_{10} concentrations in the immediate vicinity of those mines would increase slightly but would not exceed the AAQS.

Increased Railroad Emissions. There would be an additional 524 coal trains per year operating at the combined Bowie, Oxbow and West Elk Mines compared to 1998 levels. These trains would add 106 tons per year of NO_x compared to the estimated levels for 1998 (the estimated 1999 baseline emissions are listed in *Table 3.1-4, Summary of PM_{10} Emissions from Regional Mines*, and *Table 3.1-6, Tailpipe Emissions for Year 1998 Actual Baseline*). The increased emissions from the additional trains would be spread out over the entire 30-mile rail line between Somerset and Delta, so there would be no concentrated increase in the ambient air concentrations along the rail line.

3.1.3.3 Effects Common to All Alternatives

The following air quality impacts are common to all of the action alternatives:

- The continuation and possible increase in coal production at the Bowie No. 2, Oxbow Elk Creek Mine, and the West Elk Mine would cause minor increases in particulate emissions directly from the mining operations.
- The projected elevated and/or maximum levels of coal production from the Bowie No. 2 Mine, the Oxbow Elk Creek Mine, and the West Elk Mine, would result in increased coal train usage (see Section 3.14, Transportation). The increased exhaust emissions from the diesel locomotives would not be expected to cause any concentrated air quality impacts along the rail line.

3.1.3.4 Effects of Alternative B Including Cumulative Impacts

Coal Production by Regional Mines. For purposes of this section, the three local mines in the North Fork Valley are assumed to operate at the following production rates. (For Oxbow, a

Table 3.1-4
Summary of PM Emissions From Regional Mines

Facility	Annual Production (million tons per year)	PM-10 Emission Factor (lbs/ton of coal)	Annual PM-10 Emissions (tons)
Year 1998 Actual Baseline Emissions			
Bowie No. 2 Mine	1.2	0.0558	33.5
Bowie No. 1 Loadout	1.2	0.0016	1.0
Oxbow Mining	1.5	0.0259	19.4
Mountain Coal (West Elk)	5.9	0.041	120.5
Regional Total			**174**
Baseline Emissions Assuming Oxbow Operated at Planned Capacity			
Bowie No. 2 Mine	1.2	0.0558	33.5
Bowie No. 1 Loadout	1.2	0.0016	1.0
Oxbow Mining	5	0.259	64.8
Mountain Coal (West Elk)	5.9	0.041	120.5
Regional Total			**220**
No-Action Including Cumulative Impacts by Mountain Coal			
Bowie No. 2 Mine	2	0.0558	55.8
Bowie No. 1 Loadout	2	0.0016	1.6
Oxbow Mining	5	0.0259	64.8
Mountain Coal (West Elk)	8.2	0.0409	167.5
Regional Total			**290**
Proposed Project Including Cumulative Impacts by Mountain Coal			
Bowie No. 2 Mine	5	0.06138	153.5
Bowie No. 1 Loadout	5	0.0016	4.0
Oxbow Mining	5	0.0259	64.8
Mountain Coal (West Elk)	8.2	0.0409	167.7
Regional Total			**390**

Emission Factor Sources:

Bowie Resources: Allowable emission rates from most recent air quality permits
Bowie No. 2 Proposed Project: Assume 10% increase above current permits to account for possible increase in hauling along paved roads.
Oxbow Mining: Allowable emission rates from most recent air quality permits.
Mountain Coal: Assumed to be the average of Bowie Resources + Oxbow Mining.

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Table 3.1-5
Tailpipe Emissions for No-Action Including Cumulative Impact

Item	Aggregate HP	Use (hrs/yr)	Annual Usage (bhp/yr)	NOx Emission Factor (g/hp-hr)	TSP Emission Factor (g/hp-hr)	SO2 Emission Factor (g/hp-hr)	Annual NOx (tons/yr)	Annual PM10 (tons/yr)	Annual SO2 (tons/yr)
In-Mine Diesel-Powered Vehicles									
Bowie Mine @ 2 mm tpy	5,430	4000	2.2E+07	6.5	0.16	0.7	155	4	17
Oxbow Mine @ 5 mm tpy	5,430	4000	2.2E+07	6.5	0.16	0.7	155	4	17
Mtn. Coal @ 8.2 mm tpy	5,430	6560	3.6+07	6.5	0.16	0.7	255	6	27
						Regional Total	585	14	61

Item	Quantity	HP	Hr/yr	HP-hr/yr
Bowie No. 2 Mine Above-Ground Equipment				
D-9 Dozer	1	405	4722	1.9E+06
D-10 Dozer		570		0.0E+00
980 Loader	1	300	8111	2.4E+06
			Total	4.3E+06

Combined Bulldozers and Front-End Loaders	Annual Usage (bhp-hr/yr)	NOx Emission Factor (g/hp-hr)	TSP Emission Factor (g/hp-hr)	SO2 Emission Factor (g/hp-hr)	Annual NOx (tons/yr)	Annual PM10 (tons/yr)	Annual SO2 (tons/yr)
Above-Ground Diesel Equipment							
Bowie Mine @ 2 mm tpy	4,345,833	6.5	0.16	0.7	31	7	3
Oxbow Mine @ 5 mm tpy	10,858,507	6.5	0.16	0.7	78	2	8
Mtn. Coal @ 8.2 mm tpy	17,807,961	6.5	0.16	0.7	127	3	14
				Regional Total	236	13	25

Table 3.1-5
Tailpipe Emissions for No-Action Including Cumulative Impact (continued)

Item	Round Trips Per Year	RT Dist (miles)	Annual Usage	NO_x Emission Factor (g/vmt)	PM_{10} Emission Factor for Paved Road Dust (g/vmt)	SO_2 Emission Factor (g/vmt)	Annual NO_x (tons/yr)	Annual PM_{10} (tons/yr)	Annual SO_2 (tons/yr)
Bowie Mine Coal Haul Trucks at 2 Million Tons per Year Coal Production									
Coal trucks @ 28 tons per truck	71,429	5	357,143	11.44	49.2	5.7	4.5	19.4	2.2
Coal Trains Between Mine Site and Hotchkiss (Bowie at 2 Million TPY; Oxbow at 5 Million TPY; West Elk at 8.2 TPY)									
Item	**Number of Annual Trips**	**Cycle Time (hrs)**	**Annual Usage for Dual Locomotive at 2,000 hp Average (bhp-hrs/yr)**	**NO_x Emission Factor (g/bhp-hr)**	**PM_{10} Emission Factor for Paved Road Dust (g/bhp-hr)**	**SO_2 Emission Factor (g/bhp-hr)**	**Annual NO_x (tons/yr)**	**Annual PM_{10} (tons/yr)**	**Annual SO_2 (tons/yr)**
Bowie Mine Line Haul	190	3	2,285,714	13.0	0.32	0.70	30	1	2
Oxbow Mine Line Haul	476	3.5	6,666,667	13.0	0.32	0.70	95	2	5
West Elk Line Haul	781	4	12,495,238	13.0	0.32	0.70	179	4	10
Switch Mode During Coal Loading (1,000 hp)	1448	3	4,342,857	13.0	0.32	0.70	62	2	3
Regional Total	**1,448**						**307**	**9**	**17**

GRAND TOTAL 3 MINES			
	Annual NO_x (tonc/yr)	**Annual PM_{10} (tons/yr)**	**Annual SO_2 (tons/yr)**
In-Mine Vehicles	566	14	61
Above-Ground Vehicles	236	6	25
Haul trucks	4	19	2
Coal Trucks	307	8	17
Total	1114	47	105

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Table 3.1-6
Tailpipe Emissions for Year 1998 Actual Baseline

Item	Aggregate HP	Use (hrs/yr)	Annual Usage (bb-hr/yr)	NO_x Emission Factor (g/hp-hr)	TSP Emission Factor (g/hp-hr)	SO_2 Emission Factor (g/hp-hr)	Annual NO_x (tons/yr)	Annual PM_{10} (tons/yr)	Annual SO_2 (tons/yr)
In-Mine Diesel-Powered Vehicles									
Bowie Mine @ 1.2 mm tpy	5,430	4000	2.2E+07	6.5	0.16	0.7	155	4	17
Oxbow Mine @ 1.5 mm tpy	5,430	4000	2.2E+07	6.5	0.16	0.7	155	4	17
Mtn. Coal @ 7 mm tpy	5,430	5600	3.0E+07	6.5	0.16	0.7	218	5	23
						Regional Total	529	13	37

Item	Quantity	HP	Hr/yr	HP-hr/yr
Bowie No. 2 Mine Above-Ground Equipment at Nominal 1.5 mm tpy				
D-9 Dozer	1	405	4250	1.7E+06
D-10 Dozer		570		0.0E+00
980 Loader	1	300	7300	2.2E+06
			Total	3.9E+06

Combined Bulldozers and Front-End Loaders	Annual Usage (bhp-hr/yr)	NO_x Emission Factor (g/hp-hr)	TSP Emission Factor (g/hp-hr)	SO_2 Emission Factor (g/hp-hr)	Annual NO_x (tons/yr)	Annual PM_{10} (tons/yr)	Annual SO_2 (tons/yr)
Above-Ground Diesel Equipment							
Bowie Mine @ 1.2 mm tpy	3,129,000	6.5	0.16	0.7	22	1	2
Oxbow Mine @ 1.5 mm tpy	3,911,250	6.5	0.16	0.7	28	1	3
Mtn. Coal @ 7 mm tpy	14,602,000	6.5	0.16	0.7	105	3	11
				Regional Total	155	4	17

Table 3.1-6
Tailpipe Emissions for Year 1998 Actual Baseline

Item	Round Trips Per Year	RT Dist (miles)	Annual Usage	NO_x Emission Factor (g/vmt)	PM_{10} Emission Fctor for Paved Road Dust (g/vmt)	SO_2 Emission Factor (g/vmt)	Annual NO_x (tons/yr)	Annual PM_{10} (tons/yr)	Annual SO_2 (tons/yr)
Bowie Mine Coal Haul Trucks at 1.2 Million Tons per Year Coal Production									
Coal trucks @ 28 tons per truck	42,857	5	214,286	11.44	49.2	5.7	2.7	11.6	1.3
Coal Trains Between Mine Site and Delta (Bowie at 1.2 Million TPY; Oxbow at 1.5 Million TPY; West Elk at 7 TPY)									
Item	**Number of Annual Trips**	**Cycle Time (hrs)**	**Annual Usage for Dual Locomotive at 2,000 hp Average (bhp-hrs/yr)**	**NO_x Emission Factor (g/bhp-hr)**	**PM_{10} Emission Factor for Paved Road Dust (g/bhp-hr)**	**SO_2 Emission Factor (g/bhp-hr)**	**Annual NO_x (tons/yr)**	**Annual PM_{10} (tons/yr)**	**Annual SO_2 (tons/yr)**
Bowie Mine Line Haul	114	3	1,371,429	13.0	0.32	0.70	20	0	1
Oxbow Mine Line Haul	143	3.5	2,000,000	13.0	0.32	0.70	29	1	2
West Elk Line Haul	667	4	10,666,667	13.0	0.32	0.70	153	4	8
Switch Mode During Coal Loading (1,000 hp)	924	3	2,771,429	13.0	0.32	0.70	40	1	2
Regional Total	**1,448**						**201**	**5**	**11**

GRAND TOTAL 3 MINES

	Annual NO_x (tons/yr)	Annual PM_{10} (tons/yr)	Annual SO_2 (tons/yr)
In-Mine Vehicles	529	13	57
Above-Ground Vehicles	155	4	17
Haul trucks	3	12	1
Coal Trucks	201	5	11
Total	**887**	**33**	**86**

range of 4 to 6 million tons per year was identified in the alternatives. An average of 5 million tons per year was used for the analysis in this section.)

Bowie No. 2 Mine	5 million tons per year
Oxbow Mining	5 million tons per year
Mountain Coal, West Elk Mine	8.2 million tons per year
Combined Production	18.2 million tons per year

Bowie and Oxbow have applied for APEN air quality permits to allow the full production rates listed above, and Colorado APCD has issued draft permits. If Oxbow expanded to 6 million tons per year, the company would have to revise its APEN air quality permit.

The mining equipment that is permitted to operate at the two mines is listed in:

- *Table 3.1-7, Permitted Mining Processes at Bowie Resources*
- *Table 3.1-8, Permitted Mining Processes at Oxbow Mining*

Emissions From Mines, Trains, and Vehicles. The emission rates from the mining operations, haul trucks operating between the Bowie No. 2 Mine and the Bowie No. 1 Loadout, exhaust emissions from the coal trains operating at the three mines, and emissions from non-project vehicles driven through the area along State Highway 133 are listed in the following tables:

- *Table 3.1-4, Summary of PM_{10} Emissions From Regional Mines*

- *Table 3.1-9, Tailpipe Emissions for Proposed Action Including Cumulative Impacts*

- *Table 3.1-10, Estimated Emissions from Non-Project Vehicles Along State Highway 133*

- *Table 3.1-11, Emission Increases for Proposed Action and No-Action*

The overall emissions from the proposed actions and the net emission increase between the action alternatives and the No-Action Alternative are as follows:

Scenario	PM_{10} Emissions (tons/yr)	NO_x Emissions (tons/yr)	SO_2 Emissions (tons/yr)
Year 2003 Proposed Project, Including Cumulative Impact from West Elk Mine Expansion and Non-Project Traffic on Highway 133	1,758	2,045	110
Emission Increase (Action Alternatives vs. No-Action)	131	107	12
Emission Increase (Action Alternative vs Year 1998)	263	363	31

Ambient Air Quality Impacts Near Bowie No. 2 Mine and Oxbow Mine. The mines are regulated by Colorado APCD and are required to use well-operated emission control devices to minimize particulate emissions from process vents. Each mine is required to control fugitive dust by frequent watering during dry weather and by minimizing the size of storage piles.

Table 3.1-7
Permitted Mining Processing at Bowie Resources

Permit No.	Description of Processing Unit	Control Device	Permitted Annual Coal Throughput (tons/yr)	Permitted PM10 Emissions (tons/yr)
Bowie No. 2 Mine				
96DL103-1	Allis Mineral Systems Screen (1500 tph) S/N: 90KA09493	Spray Bars	5,000,000	5.25
96DL103-4	Coal loadout silo facility	Fully Enclosed	5,000,000	0.86
96DL103-6	Jeffrey model 611 flex tooth crusher (800 tph)	Spray Bars	2,500,000	1.80
96DL103-7F	Above-ground fugitive emission producing activities			4.69
	General above-ground fugitives		5,000,000	111.02
	GOB hauling		5,000,000	
	Finished Product Stockpiles (coal)		350,000	
	Finished Product Stockpiles (stoker coal)		5,000	
	raw Material Stockpiles (coal)		60,000	
	Raw Material Stockpiles (GOB)		15,000	
98DL0726	Ventilation shat w/blower rated at 850,000 cfm		5,000,000	13.95
Total Permitted PM10 Emissions				**123.6**
Bowie No. 1 Loadout Truck Dump and Rail Car Loading				
11DL252-6	Truck dump station	Mikropul Model No. 336 KTR-10 baghouse	5,000,000	0.035
11DL252-7	Silos 1-3	Mikropul Model No. 64STR-10-20 baghouse	5,000,000	0.11
11DL252-10	Rail car loading facility	Mikropul Model No. 144 STR-10-20 baghouse	5,000,000	3.67
Total Permitted PM10 Emissions				**0.5**

Table 3.1-8
Permitted Mining Processes at Oxbow Mining

Permit No.	Description of Processing Unit	Permitted Annual Coal Throughput	PM10 Emissions (tons/yr)
	Mining Related Process Sources		
	Sanborn Creek Mine	4,8000,000 tons	0.438
	Elk Creek Mine	4,800,000 tons	0.146
	Stacking Tubes	2,400,000 tons	0.111
	Loading Related Process Sources		
	Reclaim Tunnell	960,000 tons	0.075
	Screening Plant	4,800,000 tons	1.12
	Dump Station	4,800,000 tons	0.157
	Crusher	4,800,000 tons	0.29
	Crusher Bypass to Train Loadout	4,800,000 tons	0.186
	Miscellaneous	9,125 tons	0.0125
	Fugitive Sources		
	Stacking Tube Stockpile		24.2
	Temporary Stockpiles	1.72 acres	10.4
	Hauling	11,095 VMT*	2.46
	West Valley Fill		1.941
	Existing Rock Fill Area	1.21 acres	0.17
	Construction Related		13.63
Grand Total Permitted PM10 Emissions			**55.34**

* VMT = Vehicle Miles Traveled

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Table 3.1-9
Tailpipe Emissions for Proposed Action Including Cumulative Impact

Item	Aggregate HP	Use (hrs/yr)	Annual Usage (bhp-hr/yr)	NOx Emission Factor (g/hp-hr)	TSP Emission Factor (g/hp-hr)	SO_2 Emission Factor (g/hp-hr)	Annual NOx (tons/yr)	Annual PM_{10} (tons/yr)	Annual SO_2 (tons/yr)
In-Mine Diesel-Powered Vehicles									
Bowie Mine @ 5mm tpy	5,430	4000	2.2E+07	6.5	0.16	0.7	155	4	17
Oxbow Mine @ 5 mm tpy	5,430	4000	2.2E+07	6.5	0.16	0.7	155	4	17
[illegible]	5,430	656	3.6+07	6.5	0.16	0.7	255	6	27
						Regional Total	566	14	61

Item	Quantity	HP	Hr/yr	HP-hr/yr
Bowie No. 2 Mine Above-Ground Equipment at Nominal 1.5 mm tpy				
D-9 Dozer	0	405	0	0.0E+00
D-10 Dozer	2	570	5256	6.0E+06
980 Loader	2	300	8111	4.9E+06
			Total	1.1E+07

Combined Bulldozers and Front-End Loaders	Annual Usage (bhp-hr/yr)	NOx Emission Factor (g/hp-hr)	TSP Emission Factor (g/hp-hr)	SO_2 Emission Factor (g/hp-hr)	Annual NOx (tons/yr)	Annual PM_{10} (tons/yr)	Annual SO_2 (tons/yr)
Above-Ground Diesel Equipment							
Bowie Mine @ 5 mm tpy	10,858,507	6.5	0.16	0.7	78	2	8
Oxbow Mine @ 5 mm tpy	10,858,507	6.5	0.16	0.7	78	2	8
Mtn. Coal @ 8.2 mm tpy	17,807,951	6.5	0.16	0.7	127	3	14
				Regional Total	283	7	30

Table 3.1-9
Tailpipe Emissions for Proposed Action Including Cumulative Impact

Item	Round Trips Per Year	RT Dist (miles)	Annual Usage (vmt/yr)	NO$_x$ Emission Factor (g/vmt)	PM$_{10}$ Emission Fctor for Paved Road Dust (g/vmt)	SO$_2$ Emission Factor (g/vmt)	Annual NO$_x$ (tons/yr)	Annual PM$_{10}$ (tons/yr)	Annual SO$_2$ (tons/yr)
Bowie Mine Coal Haul Trucks at 5.2 Million Tons per Year Coal Production									
Coal trucks @ 28 tons per truck	178,571	5	892,857	11.44	49.2	5.7	11.2	48.4	5.6
Coal Trains Between Mine Site and Delta (Bowie at 5 Million TPY; Oxbow at 5 Million TPY; West Elk at 8.2 TPY)									
Item	**Number of Annual Trips**	**Cycle Time (hrs)**	**Annual Usage for Dual Locomotive at 2,000 hp Average (bhp-hrs/yr)**	**NO$_x$ Emission Factor (g/bhp-hr)**	**PM$_{10}$ Emission Factor for Paved Road Duct (g/bhp-hr)**	**SO$_2$ Emission Factor (g/bhp-hr)**	**Annual NO$_x$ (tons/yr)**	**Annual PM$_{10}$ (tons/yr)**	**Annual SO$_2$ (tons/yr)**
Bowie Mine Line Haul	476	3	5,714,286	13.0	0.32	0.70	82	2	4
Oxbow Mine Line Haul	476	3.5	6,666,667	13.0	0.32	0.70	95	2	5
West Elk Line Haul	781	4	12,495,238	13.0	0.32	0.70	179	4	10
Switch Mode During Coal Loading (1,000 hp)	1733	3	5,200,000	13.0	0.32	0.70	74	2	4
Regional Total	**1,733**						**356**	**9**	**19**

GRAND TOTAL 3 MINES			
	Annual NO$_x$ (tons/yr)	**Annual PM$_{10}$ (tons/yr)**	**Annual SO$_2$ (tons/yr)**
In-Mine Vehicles	566	14	61
Above-Ground Vehicles	283	7	30
Haul trucks	11	48	6
Coal Trucks	356	9	19
Total	**1216**	**78**	**116**

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Table 3.1-10
Estimated Emissions From Non-Project Vehicles Along Highway 133

Road Segment	Highway Distance (miles)	ADT (Veh/day)	Cars (Assume 85% of ADT)		Medium Diesel Trucks (Assume 10% of ADT)		Heavy Diesel Trucks (Assume 5% of ADT)		Total Emissions From Highway 133
			Count	VMT/day	Count	VMT/day	Count	VMT/day	
Delta-Austin	6.4	12,600	10,710	68,544	1,260	8,064	630	4,032	
Austin-Hotchkiss	14.4	5,400	4,590	66,096	540	7,776	270	3,888	
Hotchkiss-Somerset	20.8	3,150	2,678	55,692	315	6,552	158	3,276	
Somerset-West Elk	3	2,000	1,700	5,100	200	600	100	300	
Regional Total				195,432		22,992		11,496	
NO_x EF, g/VMT				2.0		5.0		11.4	
Road Dust EF, g/VMT				1.05		11.7		87	
SO_2 EF, g/VMT				0		1		5.7	
NO_x Emission tons/yr				157.12		46.21		52.68	256
Road Dust tons/yr				82.49		108.14		402.04	593
SO_2 Emission, tons/yr						9.24		26.34	36

Basis: Year 1996 ADT Vehicle Counts From Colorado Department of Transportation
Emission Factors: EPA MOBIL4 and AP-42 Section 13.2.1

Table 3.1-11
Emission Increase for Proposed Action and No-Action

Source	Year 1998 Baseline (mm tpy)	No-Action (mm tpy)	Proposed Action (mm tpy)
Coal Production Rates			
Bowie	1.2	2	5
Oxbow	1.5	5	5
West Elk	5.9	8.2	8.2
Total	**8.5**	**15.2**	**18.2**
Grand Total Regional Emissions: NOx			
West Elk Mine	496	600	600
Oxbow Mine	222	348	348
Bowie Resources	208	233	341
Highway 133	256	256	256
Regional Industrial/Agric.	200	200	200
Urban Areas (Delta, Hotchkiss, Paonia)	300	300	300
Total	**1,682**	**1,937**	**2,045**
Grand Total Regional Emissions: PM_{10}			
West Elk Mine	129	181	181
Oxbow Mine	25	73	73
Bowie Resources	51	82	214
Highway 133	590	590	590
Regional Industrial/Agric.	500	500	500
Urban Areas (Delta, Hotchkiss, Paonia	200	200	200
Total	**1,495**	**1,626**	**1,758**

Table 3.1-11
Emission Increases for Proposed Action and No-Action

Source	PM_{10}		NOx		SO_2	
	Proposed Action Minus No-Action	Proposed Action Minus Year 1998 Baseline (includes cumulative impacts)	Proposed Action Minus No-Action	Proposed Action Minus Year 1998 Baseline (includes cumulative impacts)	Proposed Action Minus No-Action	Proposed Action Minus Year 1998 Baseline (includes cumulativ e impacts)
Emission Increases Input to Models (tons/year)						
West Elk Mine	0	52	0	69	0	6
Oxbow Mine	0	48	0	68	0	5
Bowie No. 2 Mine	98	120	47	49	5	6
Haul Trucks	29	36	6.5	7.5	4	5
Bowie Rail Facility	2.4	3	11	13	0.5	1
RR Line 4	0	1	0	39	0	2
RR Line 3	0.5	1	14	39	0.8	2
RR Line 2	0.5	1	14	39	0.8	2
RR Line 1	0.5	1	14	39	0.8	2
Total Tons/Year	**131**	**263**	**107**	**636**	**12**	**31**
% of Baseline	**9%**	**18%**	**6%**	**22%**		

APCD required Oxbow to conduct air quality dispersion modeling at the mine, as part of the permitting process for the expansion up to the proposed 5 million ton per day throughput (**Air Sciences, 1999**). The modeling was completed using EPA's ISC3 dispersion model with one year of sequential-hourly meteorological data from the nearby West Elk Mine. A detailed modeling receptor grid was used to evaluate impacts at residential areas and rural areas surrounding the mine site. The results of the modeling demonstrated that the Oxbow Mine achieves the 24-hour and annual-average PM_{10} concentration limits at all points beyond the facility boundary:

Averaging Period	PM_{10} Impact by Mine Emissions Alone ($\mu g/m3$)	Assumed Background Concentration ($\mu g/m3$)	Total Concentration From Mine Emissions Plus Background ($\mu g/m3$)	Ambient Air Quality Standard ($\mu g/m3$)
24-hour Average	112	10	122	150
Annual Average	22	10	32	50

It is generally recognized that the ISC3 dispersion model predicts a conservatively high impact, so it is concluded that the PM_{10} impacts surrounding the Oxbow Mine would be below the AAQS if Oxbow operates the air pollution control equipment in accordance with their APEN air quality permit. The PM_{10} AAQS limits are "secondary standards" that were specified by EPA to prevent "public welfare" impacts such as soiling of buildings and crop damage, as well as protecting public health. The modeled maximum PM_{10} concentrations at the facility boundary were less than the AAQS.

The Bowie No. 2 coal processing equipment is farther from the facility boundary than is the equipment at Oxbow, so it is assumed that the PM_{10} concentrations at the Bowie No. 2 facility boundary are lower than at Oxbow. Similarly, the train loading facilities at the Bowie No. 1 Loadout are farther from the facility boundary than is the train loading station at Oxbow, so the PM_{10} concentrations adjacent to the Bowie No. 1 Loadout would be less than Oxbow and would also be less than AAQS.

The action alternatives would require an estimated five to six coal trains per day to travel to and from the project area. Based on emission factors developed by EPA (EPA, 1997) the diesel locomotives would emit an estimated 356 tons per year of NO_x and 9 tons per year of particulate matter along the 30-mile rail line between Somerset and Delta. The windblown coal dust from the coal cars is expected to be much less than the particulate emitted from the diesel engine exhaust. All diesel engines are recognized to emit trace amounts of organic compounds (for example, aldehydes) that can cause short-term odor impacts. There could be minor, short-term odor impacts along the railroad line between Somerset and Delta.

Greenhouse Gas Emissions. "Greenhouse gases" are gaseous emissions that have extremely long persistence in the atmosphere, disperse globally, and can result in global warming. Greenhouse gas emissions are not a local issue; the emitted gases have no immediate impact near the emission point but eventually disperse across the planet. Two types of greenhouse gases are associated with the coal mines in the North Fork of the Gunnison River area: methane and carbon dioxide.

Methane gas is liberated from the coal formations during mining and emitted to the atmosphere through the ventilation shafts. At the assumed coal production rates of 5 million tons per year, the Bowie No. 2 Mine and the Oxbow Elk Creek Mine would emit some very minor amounts of methane. The methane concentrations in the ventilation air would be well below the flammability limit, and there is no realistic possibility that the methane emitted from the vents could accumulate in buildings outside the mine to create a hazard from explosion.

Carbon dioxide is not generated in significant amounts by the mining operations, but carbon dioxide is the primary combustion product of coal, such as in electric generating stations.

3.1.3.5 Air Quality Impacts to West Elk Wilderness and Black Canyon National Monument

The Action Alternatives would increase emissions of particulate matter, NO_x and SO_2 from sources along the floor of the North fork of the Gunnison River valley. If the wind blows these emissions in a direction other than directly along the valley, it is possible that they could impact the West Elk Wilderness or Black Canyon National Monument (*Figure 3.1-2, Emission Sources and Wilderness Area Receptors for Visibility and Acid Deposition Modeling*). The emitted NO_x and SO_2 can react inside the plume to convert to nitric acid and sulfuric acid, which can cause increases in acid deposition at the sensitive alpine regions of the wilderness area. The nitric acid and sulfuric acid can react with ammonia in the atmosphere to form "secondary particles" that can form a regional haze that impacts visibility at locations far from the emission source. In addition, the emissions can cause an unattractive distinct plume (called "plume blight") during the first few miles downwind before the plume breaks up as it travels through rugged terrain.

The worst-case potential impacts by acid deposition at the West Elk Wilderness and the regional haze impacts at West Elk Wilderness and Black Canyon were calculated using a refinement of the Level I screening procedure described in the document "Interagency Workgroup on Air Quality Modeling, Phase I Report" (IWAQM, 1993), referred to as "IWAQM-1". The impacts of plume blight within the first few miles downwind of the mines were evaluated using the PLUVUE visibility model (EPA, 1992). The impacts were evaluated at the following wilderness area receptors:

- Regional haze and plume blight were evaluated at the top of Mt. Gunnison at the northwest boundary of the West Elk Wilderness (11 miles from the town on Bowie), looking downward toward the mine sites.
- Acid deposition impacts were evaluated at South Golden Lake at the center of the West Elk Wilderness (22 miles from the town of Bowie)
- Regional haze impacts were evaluated at the northeast corner of the Black Canyon National Monument (25 miles from the town of Bowie)

General Approach for Dispersion Modeling - The key to the impact assessment was conducted to estimate the concentrations of PM_{10}, NO_x and SO_2 at the West Elk Wilderness and Black Canyon caused by emissions from the mines, highways and railroad along the valley floor. To reach the interior of the West Elk Wilderness, the emissions would have to rise out of the valley at 6,000 feet elevation and travel southwest along a circuitous path: past Jumbo Mountain, West Flatiron Ridge and East Flatiron Ridge to reach the northwest wilderness boundary, then onward either over or around Mt. Gunnison (12,700 feet), West Beckwith Mountain (12,100 feet) and Sheep Mountain (11,800 feet).

The conceptual pathway for emissions impacting the Black Canyon National Monument would be equally serpentine. Emissions from the valley floor at Paonia and Somerset could travel westward along the North Fork of the Gunnison River valley to the broad plane at Hotchkiss, then southward across the Smith River, over the top of Fruitland Mesa, across Red Canyon, then southward to Black Canyon (25 miles from the source).

There are no conventional air quality dispersion models that can accurately simulate ground-level plume dispersion in such twisting, rugged terrain. Therefore, for this EIS, a conservative screening approach was used to estimate the worst-case impacts and compare them to relevant environmental criteria. As a highly conservative step, it was assumed that emissions from the mine sources at the valley floor blow downwind directly toward the wilderness areas as a straight, continuous, uniform plume with no enhanced dispersion caused by crossing valleys, rugged terrain, temperature inversions, etc. Given this assumption, two commonly-used Gaussian dispersion models (SCREEN3 and PLUVUE) were used to estimate the annual average concentrations and the maximum 24-hour average concentrations at the wilderness areas. The SCREEN3 model was used for the acid deposition modeling and the regional haze modeling. The PLUVUE model was used to assess plume blight immediately downwind of the

Bowie No. 2 Mine. Based on the rugged terrain described above, the use of these Gaussian dispersion models is considered to provide a conservatively high ambient concentration. The actual impacts at the wilderness areas are expected to be considerably lower than the modeled impacts presented in this EIS.

Wind speed data from the meteorological tower that was operated at the West Elk mine in 1987 were used for the modeling. That station is believed to provide the most relevant source of wind data for the Paonia-Somerset region. The wind rose shown in *Figure 8, Wind Rose for West Elk Mine*, displays a wind pattern that is common for a narrow river valley. Strong persistent winds blow along the valley, and weak infrequent winds blow across the valley. The prevailing winds blow up-valley or down-valley with a high wind speed (3.8 meters/second average). Cross-valley winds blowing southward toward the West Elk Wilderness were infrequent (less than 2% frequency of occurrence) with a low speed (2.5 meters per second). The average wind speed for all directions was 3.6 meters per second. Based on the West Elk wind rose, the following values were used for the SCREEN3 modeling:

- Annual average wind speed of 2.5 meters per second, D stability, and 5 percent per year frequency of annual occurrence (i.e., the wind direction was assumed to meander so all of the emission sources between Somerset and Delta impact the wilderness areas for 5% of the time during the year).

- 24-hour average wind speed of 2.5 meters per second, D stability, and 6 hours per day occurrence (i.e., the wind direction was assumed to meander so all of the emission sources between Somerset and Delta would impact the wilderness areas for 6 hours).

Emission Sources Used for Modeling - The visibility modeling and acid deposition assessments were done by modeling the incremental emission increases for the following two scenarios. The modeled incremental impacts were then compared to measured baseline conditions to evaluate the significance of the modeled increases.

"Action Alternative Minus No-Action". This scenario evaluates emission increases from mining of the Iron Point Coal Lease Tract (by Bowie) and the Elk Creek Coal Lease Tract (by Oxbow).

"Action Alternative Minus Year 1998 Baseline". This scenario includes the direct emission increases from mining of the Iron Point Coal Lease Tract (by Bowie) and the Elk Creek Coal Lease Tract (by Oxbow), plus cumulative impact emission increases that are expected to occur at the West Elk Mine.

Table 3.1-11, Emission Increases for Proposed Action and No-Action, lists the incremental emission increases for the two scenarios as well as the estimated grand total regional emission rates for the Year 1998 baseline, No-Action, and Action Alternative. As shown in *Figure 9, Emission Sources and Wilderness Area Receptors Used for Visibility and Acid Deposition Modeling*, the three mines that could impact the West Elk Wilderness are spread along a 3-mile line between Paonia and Somerset, and the railroad emissions would occur along the 30-mile track between Somerset and Delta. For the SCREEN3 modeling, the emission increases were apportioned between nine discrete area sources to represent the three mines and the railroad.

Modeled Pollutant Concentrations at West Elk Wilderness and Black Canyon - Detailed modeling results are described in an independent technical report (Kennedy/Jenks, 1999). The results are summarized in *Table 3.1-12, Visibility and Acid Deposition Modeling Results*".

The highest concentrations of ambient NO_x and PM_{10} were modeled at the Mt. Gunnison receptor, which is closest to the three mines. The modeled annual-average NO_2 increment at Mt. Gunnison is 0.069 μg/m3, which is below the PSD Class I allowable increment of 2,5 μg/m3. The maximum 24-hour total PM_{10} concentration at Mt. Gunnison (including primary mine dust plus secondary aerosols formed by reaction of NO_x and SO_2 emissions) is 0.24 μg/m3, which is below the PSD Class I allowable increment of 8 μg/m3.

As listed in *Table 3.1-12, Visibility and Acid Deposition Modeling Results*, the modeled concentrations at South Golden Lake and Black Canyon are lower than the modeled values at Mt. Gunnison because those receptors are farther from the large emission sources.

Modeled Acid Deposition at South Golden Lake in West Elk Wilderness - Impacts from acid deposition were evaluated using the conservative screening procedure developed by the Forest Service (Fox et. al., 1983). Calculations are shown in *Table 3.1-13, Annual ANC Change at South Golden Lake (Action Alt. – No-Action)* and in *Table 3.1-14, Annual ANC Change at South Golden Lake (Action Alt. – Year 1998 Baseline)*. The modeled decrease in the acid neutralization capacity (ANC) at South Golden Lake was less than the criterion defining a "significant impact". The steps for the acid deposition assessment were as follows:

- The annual average NO_x and SO_2 concentrations were modeled by SCREEN3 using the steps described previously.
- The "dry deposition rates" for NO_x and SO_2 were estimated using deposition velocities of 0.007 m/sec and 0.024 m/sec, respectively.
- The total deposition of nitrogen and sulfur were estimated by assuming that the total deposition is twice the dry deposition.
- The Year 1998 baseline alkalinity of South Golden Lake was assumed to be 114 microequivalents per liter (μeq/l) based on information from the Forest Service.
- Annual average precipitation at South Golden Lake was assumed to be 40 inches based on information from the Forest Service

The Forest Service considers a decrease in the ANC of 10 percent to constitute a significant impact. The modeled impacts are below that criterion:

Action Alternative Minus No Action (Does not include any cumulative impacts)	0.2%
Action Alternative Minus Year 1998 Baseline (Includes cumulative impacts)	0.7%

Modeled Regional Haze Impacts - Emissions of inert coal dust, NOx and SO2 from the mines and haul road could react in the atmosphere to form particles that could form a discernible haze over regions far from the mines. The following steps were used to estimate the impacts of PM_{10}, NO_x and SO_2 emissions on visibility:

Table 3.1-12
Visibility and Acid Deposition Modeling Results

Assumed Background Conditions		
Background Visual Range at West Elk Wilderness (clearest 90th percentile)	290	km
Background Visual Range at Black Canyon (clearest 90th percentile)	200	km
Background ANC at S. Golden Lake	114	ueg/l
"Cross-Valley" Wind Speed	2.5	m/sec
Annual-average "Cross-valley" Frequency of Occurrence for SCREEN3	5%	
Highest-day, "Cross-valley Wind" Frequency of Occurrence for SCREEN3	25%	
Assumed 24-hr Average Ambient Temperature at West Elk Wilderness	70	deg F
Assumed Relative Humidity on 90% Clearest Day	60%	
Assumed Ozone Concentration (10% of AAQS)	0.008	ppm
Maximum Daily NO_2 Conversion Rate	10%	per hour
Maximum Daily SO_2 Conversion Rate	1%	per hour
Modeled Criteria Pollutant Concentrations		
Annual Nox Increment at S. Golden Lake, Proposed Action-Year 1998 Baseline	0.019	μg/m3
Annual Nox Increment at S. Golden Lake, Proposed Action - No-Action	0.069	μg/m3
24-hr Primary PM10 Increment at Mt. Gunnison, Proposed Action-Year 1998 Baseline	0.18	μg/m3
24-hr Total PM_{10} Increment (Primary + Secondary) at Mt. Gunnison Proposed Action - Year 1998 Baseline	0.24	μg/m3
Reduced Acid Neutralization Capacity (Significant Impact = 10%)		
Reduced ANC at S. Golden Lake (Proposed Action - No-Action)	0.20%	
Reduced ANC at S. Golden Lake (Proposed Action - Year 1998 Baseline)	0.66%	
Increased Extinction Coefficient (Significant Impact = 10%)		
Increased B-ext at S. Golden Lake, Proposed Action - No-Action	4.3%	
Increased B-ext at S. Golden Lake, Proposed Action - Year 1998 Baseline	10.6%	
Increased B-ext at Mt. Gunnison, Proposed Action - No Action	5.3%	
Increased B-ext at Mt. Gunnison, Proposed Action - Year 1998 Baseline	13.0%	
Increased B-ext at Black Canyon, Proposed Action - No-Action	1.4%	
Increased B-ext at Black Canyon, Proposed Action - Year 1998 Baseline	3.4%	

Table 3.1-12
Visibility and Acid Deposition Modeling Results

PLUVUE Plume Visibility, Mt. Gunnison Viewer Looking within 10° of Bowie No. 2 Mine (significant impact = 2.0)	
Delta E, 1 Hour After Sunrise, Wind Condition = F/1.0	0.76
Delta E, 1 Hour After Sunrise, Wind Condition = D/3.6	0.55
Delta E, Noon, Wind Condition = F/1.0	0.89
Delta E, Noon, Wind Condition - D/3.6	0.22
Delta E, 1 Hour Before Sunset, Wind Condition = F/1.0	5.57
Delta E, 1 Hour Before Sunset, Wind Condition = D/3.6	1.42

- The visibility assessment focused on the impacts during exceptionally clear days. Clear days are defined by the "background visual range" which is the distance that a dark mountain would be barely visible against the sky. Based on data provided by Forest Service and the National Park Service, the 90th percentile clearest days at the West Elk Wilderness and the Black Canyon have visual ranges of 290 km and 200 km, respectively.

- The SCREEN3 model was used to calculate the downwind concentrations of mine dust, NO_x and SO_2.

- The National Park Service's criterion for "significant impact" is based on a 24-hour average. The SCREEN3 values for the maximum 1-hour impacts were multiplied by a factor of 0.25 to convert to a 24-hour average. The 0.25 factor is commonly used for air quality modeling.

- NO_x and SO_2 must first react within the plume to form nitric acid and sulfuric acid before they can form "secondary particles" that can obscure visibility. The reaction rates for those pollutants depend on the air temperature, amount of solar radiation, amount of ambient ozone, and the relative humidity. Based on a clear day in July, the following meteorological parameters were assumed:

Air temperature:	70 degrees at West Elk Wilderness 80 degrees at Black Canyon of the Gunnison National Monument
Solar radiation:	Mid-day on July 4
Ambient ozone:	0.008 ppm (1/10 the allowable AAQS)
Relative humidity:	60%

- Based on the above ambient conditions, the PLUVUE model predicts mid-day reaction rates of 5 percent per hour for NO_x and 0.7 percent per hour for SO_2 for the West Elk receptor. As a conservative step, the PLUVUE-modeled reaction rates for the West Elk were adjusted upward to 10 percent per hour for NO_x and 1 percent per hour for SO_2. The PLUVUE reaction rates at the Black Canyon of the Gunnison National Monument (which is lower in elevation and hotter than West Elk) were 7

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Table 3.1-13
Annual ANC Change at South Golden Lake
(Action Alternative - No-Action does not include emission increases from non-project cumulative impacts)

Baseline Conditions at South Golden Lake	
Alkalinity	141 µeg/l
Precipitation	40 inches

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN 3 X/Q (µg/m3/g/sec)	Increased NO$_x$ Emissions, Proposed Project - No-Action (tpy)	NO$_x$ Emissions (g/s)	SCREEN3 1-Hr NO$_x$ Conc. (µg/m^3)	SCREEN3 Annual NO$_x$ Conc. (µg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Deposition (µg/m3)
NO$_x$ - NO$_3$ Conversion		**100.0% Per Hour**			**SCREEN3 Annual Factor**		**0.05**		
West Elk Mine	27400	3.0	0.1545	0	0.00	0.0000	0.0000	1.00	0.0000
Oxbow Mine	31000	3.4	0.144	0	0,00	0.0000	0.0000	1.00	0.0000
Bowie No. 2 Mine	35400	3.9	0.135	47	1.35	0.1827	0.0091	1.00	0.00913
Haul Trucks	36000	4.0	0.133	6.5	0.19	0.0249	0.0012	1.00	0.00124
Bowie Rail Facility	36600	4.1	0.132	11	0.32	0.0418	0.0021	1.00	0.00209
RR Line 4	33700	3.7	0.138	0	0.00	0.0000	0.0000	1.00	0.0000
Rr Line 3	39500	4.4	0.127	14	0.40	0.0512	0.0026	1.00	0.00256
RR Line 2	50300	5.6	0.112	14	0.40	0.0451	0.0023	1.00	0.00226
RR Line 1	68600	7.6	0.095	14	0.40	0.0383	0.0019	1.00	0.00191
NO$_2$ Available for Deposition				**107**		**0.384**	**0.019**		**0.0192**
Mojar Ratio R, N/NO$_2$									0.30
NO$_2$ Deposition Velocity Vd, m/sec									0.007

Table 3.1-13
Annual ANC Change at South Golden Lake
(Action Alternative - No-Action does not include emission increases from non-project cumulative impacts)

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN 3 X/Q (µg/m3/g/sec)	Increased NO_x Emissions, Proposed Project - No-Action (tpy)	NO_x Emissions (g/s)	SCREEN3 1-Hr NO_x Conc. (µg/m^3)	SCREEN3 Annual NO_x Conc. (µg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Deposition (µg/m3)
DEP (total-to-dry ratio)									2
Units Correction Fc									315.4
Nitrogen Flux, kg N/ha/year									0.026
SO_2-SO_3 Conversion			100.0% Per Hour	SCREEN 3 Annual Factor			0.05		
West Elk Mine	27400	3.0	0.1545	0	0.00	0.0000	0.0000	1.00	0.00000
Oxbow Mine	31000	2.4	0.144	0	0.00	0.0000	0.0000	1.00	0.00000
Bowie No. 2 Mine	35400	2.7	0.135	5	0.14	0.0194	0.0010	1.00	0.00097
Haul Trucks	36000	2.8	0.133	4	0.12	0.0153	0.0008	1.00	0.00077
Bowie Rail Facility	36600	2.8	0.132	0.5	0.01	0.0019	0.0001	1.00	0.00010
RR Line 4	33700	2.6	0.138	0	0.00	0.000	0.0000	1.00	0.00000
RR Line 3	39500	3.0	0.127	0.8	0.02	0.0029	0.0001	1.00	0.00015
RR Line 2	50300	3.9	0.112	0.8	0.02	0.0026	0.0001	1.00	0.00013
RR Line 1	68600	5.3	0.095	0.8	0.02	0.0022	0.0001	1.00	0.00011
SO_2 Available for Deposition				12		0.044	0.0022		0.00222
Mojar Ratio R, N/NO_2									0.50
NO_2 Deposition Velocity Vd, m/sec									0.024

Table 3.1-13
Annual ANC Change at South Golden Lake
(Action Alternative - No-Action does not include emission increases from non-project cumulative impacts)

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN 3 X/Q (µg/m3/g/sec)	Increased NOx Emissions, Proposed Project - No-Action (tpy)	NOx Emissions (g/s)	SCREEN3 1-Hr NOx Conc. (µg/m^3)	SCREEN3 Annual NOx Conc. (µg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Deposition (µg/m3)
DEP (total-to-dry ratio)									2
Units Correction Fc									315.4
Nitrogen Flux, kg N/ha/year									**0.0168**

Unit Conversions	
Alkalinity	0.000141 eq/l
Precipitation	1.02 meters
N Flux Dn	0.0258 kg/ha/yr
S Flux Ds	0.0168 kg/ha/yr
Rn Factor (N/NO2)	0.30
Rn Factor (S/SO2)	0.5
Nitrogen Eq. Flux Hn	0.000184 eg/m2
Sulfur Equ. Flux Hs	0.000105 eg/m2

Wind Speed: 2.5 m/sec and D stability based on local "cross-valley" wind data

Basis: D.G. Fox, 1983, "A Suggested Methodology for an Acid Deposition Screening Technique Applicable Within 200 km of Isolated Sources", Preliminary Draft, 1983.

Equations:
Total Flux (kg/ha/yr = (Conc.) X Vd x R x DEP x Fc
Hn = Dn/(10 x Rn x 46)
Hs = Da/(10 x Rs x 32)
Delta ANC (%) = 100 * [(Hs+Hn)/d/1000/A]
Delta ANC **0.202%**

SCREEN3 Dispersion Modeling Assumptions:

SCREEN3 model was used, dividing the mine sites, haul roads, and railroad into discrete point sources for modeling the concentration at West Elk.

SCREEN3 model assumed 2.5 mps "cross-valley" wind speed based on annual average condition at West Elk weather station.

Table 3.1-14
Annual ANC Change at South Golden Lake
(Action Alternative - Year 1998 baseline includes emission increases from non-project cumulative impacts)

Baseline Conditions at South Golden Lake	
Alkalinity	141 µeg/l
Precipitation	40 inches

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN 3 X/Q (µg/m3/g/sec)	Increased NO_x Emissions, Proposed Project - No-Action (tpy)	NO_x Emissions (g/s)	SCREEN3 1-Hr NO_x Conc. (µg/m^3)	SCREEN3 Annual NO_x Conc. (µg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Deposition (µg/m3)
NO_x - NO3 Conversion		100.0% Per Hour		SCREEN3 Annual Factor			0.05		
West Elk Mine	27400	3.0	0.1545	69	1.99	0.3069	0.0153	1.00	0.01535
Oxbow Mine	31000	3.4	0.144	68	1.96	0.2819	0.0141	1.00	0.01410
Bowie No. 2 Mine	35400	3.9	0.135	49	1.41	0.1905	0.0095	1.00	0.00952
Haul Trucks	36000	4.0	0.133	7.5	0.22	0.0287	0.0014	1.00	0.00144
Bowie Rail Facility	36600	4.1	0.132	13	0.37	0.0494	0.0025	1.00	0.00247
RR Line 4	33700	3.7	0.138	39	1.12	0.1550	0.0077	1.00	0.00775
Rr Line 3	39500	4.4	0.127	39	1.12	0.1426	0.0071	1.00	0.00713
RR Line 2	50300	5.6	0.112	39	1.12	0.1258	0.0063	1.00	0.00629
RR Line 1	68600	7.6	0.095	39	1.12	0.1067	0.0053	1.00	0.00533
NO_2 Available for Deposition				383		1.387	0.069		0.0694
Mojar Ratio R, N/NO_2									0.30
NO_2 Deposition Velocity Vd, m/sec									0.007

Table 3.1-14
Annual ANC Change at South Golden Lake
(Action Alternative - Year 1996 baseline includes emission increases from non-project cumulative impacts)

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN 3 X/Q (µg/m3/g/sec)	Increased NOx Emissions, Proposed Project - No-Action (tpy)	NOx Emissions (g/s)	SCREEN3 1-Hr NOx Conc. (µg/m^3)	SCREEN3 Annual NOx Conc. (µg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Deposition (µg/m3)
DEP (total-to-dry ratio)									2
Units Correction Fc									315.4
Nitrogen Flux, kg N/ha/year									0.093
SO₂-SO₃ Conversion		100.0% Per Hour		SCREEN 3 Annual Factor			0.05		
West Elk Mine	27400	3.0	0.1545	6	0.17	0.0267	0.0013345	1.00	0.00133
Oxbow Mine	31000	3.4	0.144	5	0.14	0.0207	0.0010365	1.00	0.00104
Bowie No. 2 Mine	35400	3.9	0.135	6	0.17	0.0233	0.0011661	1.00	0.00117
Haul Trucks	36000	4.0	0.133	5	0.14	0.0191	0.0009574	1.00	0.00096
Bowie Rail Facility	36600	4.1	0.132	1	0.03	0.0038	0.0002	1.00	0.00019
RR Line 4	33700	3.7	0.138	2	0.06	0.0079	0.0004	1.00	0.00040
Rr Line 3	39500	4.4	0.127	2	0.06	0.0073	0.0004	1.00	0.00037
RR Line 2	50300	5.6	0.112	2	0.06	0.0064	0.0003	1.00	0.00032
RR Line 1	68600	7.6	0.095	2	0.06	0.0055	0.0003	1.00	0.00027
SO₂ Available for Deposition				31		0.121	0.0060		0.00604
Molar Ratio R, N/NO₂									0.50
NO₂ Deposition Velocity Vd, m/sec									0.024

Table 3.1-14
Annual ANC Change at South Golden Lake
(Action Alternative - Year 1998 baseline includes emission increases from non-project cumulative impacts)

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN 3 X/Q (μg/m3/g/sec)	Increased NO_x Emissions, Proposed Project - No-Action (tpy)	NO_x Emissions (g/s)	SCREEN3 1-Hr NO_x Conc. (μg/m^3)	SCREEN3 Annual NO_x Conc. (μg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Deposition (μg/m3)
DEP (total-to-dry ratio)									2
Units Correction Fc									315.4
Nitrogen Flux, kg N/ha/year									0.0457

Unit Conversions	
Alkalinity	0.000141 eq/l
Precipitation	1.02 meters
N Flux Dn	0.0932 kg/ha/yr
S Flux Ds	0.0457 kg/ha/yr
Rn Factor (N/NO_2)	0.30
Rn Factor (S/SO_2)	0.5
Nitrogen Eq. Flux Hn	0.000666 eg/m2
Sulfur Equ. Flux Hs	0.000286 eg/m2

Wind Speed: 2.5 m/sec and D stability based on local "cross-valley" wind data

Basis: D.G. Fox, 1983, "A Suggested Methodology for an Acid Deposition Screening Technique Applicable Within 200 km of Isolated Sources", Preliminary Draft, 1983.

Equations:

Total Flux (kg/ha/yr = (Conc.) X Vd x R x DEP x Fc

Hs = Ds/(10 x Rs x 32)

Hn = Dn/(10 x Rn x 46)

Delta ANC (%) = 100 * [(Hs+Hn)/d/1000/A]

Delta ANC **0.664%**

SCREEN3 Dispersion Modeling Assumptions:

SCREEN3 model was used, dividing the mine sites, haul roads, and railroad into discrete point sources for modeling the concentration at West Elk.

SCREEN3 model assumed 2.5 mps "cross-valley" wind speed based on annual average condition at West Elk weather station.

percent per hour for NO_x and 0.7 percent per hour for SO_2.. As a conservative step, the PLUVUE rates were adjusted upward to 14 percent per hour for NO_x and 1.5% per hour for SO_2.

- The resulting primary particulate and secondary particulate concentrations were converted to a "light extinction coefficient" (b-ext, with units of 1/km) using the IWAQM-1 factor 0.003 b-ext per μg/m3 of total particulate (the sum of primary PM_{10}, secondary ammonium nitrate, and secondary ammonium sulfate).

- The background visual range (VR) at each receptor was converted to a background b-ext coefficient by the Koschmeider equation:

$$\text{Background b-ext} = \ln(0.02) / VR$$

- The National Park Service staff indicated a "significant impact" to be an incremental b-ext increase of 10 percent above background.

Calculations were completed for the "Action Alternative Minus Baseline" and the "Action Alternative Minus No-Action" scenarios, at each of the three wilderness area receptors (Kennedy/Jenks, 1999). Example calculations are shown in *Table 3.1-15, B-ext Increase at Mt. Gunnison (Action Alternative Minus No-Action* and *Table 3.1-16, B-ext Increase at Black Canyon (Action Alternative Minus No-Action*. Modeled impacts for all of the scenarios at each of the receptors are listed in *Table 3.1-12, Visibility and Acid Deposition Modeling Results*.

Secondary aerosols produced by reaction of NO_x and SO_2 in the plumes contributed to the total ambient particulate. Combined ammonium nitrate and ammonium sulfate particulate contributed 30 percent of the total ambient particulate at Mt. Gunnison and 35 percent of the total particulate at the Black Canyon of the Gunnison National Monument.

For the "Action Alternative Minus No-Action" scenario that does not include any cumulative impacts, the modeled increases in b-ext were less than the NPS impact criterion of 10 percent, as follows:

Mt. Gunnison	5% increase above background
South Golden Lake	4%
Black Canyon	1%

For the "Action Alternative Minus 1998 Baseline" scenario that includes cumulative impacts, the modeled increases in b-ext exceeded the NPS impact criterion of 10 percent, as follows:

Mt. Gunnison	13% increase above background
South Golden Lake	11%
Black Canyon	3%

"Plume Blight" Near West Elk Wilderness Overlooking Gunnison River - In some cases when the wind direction and the sun are aligned, an observer on a high ridge overlooking the North Fork of the Gunnison River valley could see a distinct dust plume emitted by any of the coal mines. This visual impact caused by a distinct plume emitted from a distinct source is called "plume blight". Plume blight is different from regional haze where the viewer can perceive visibility degradation but the location of the emission source cannot be identified. The

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Table 3.1-15
B-Ext Increase at Mt. Gunnison
(Proposed Action - No-Action)

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN3 X/Q (µg/m3/g/sec)	Increased NO_x Emissions, Proposed Project - No-Action (tpy)	NO_x Emissions (g/s)	SCREEN3 1-Hr NO_x Conc. (µg/m^3)	SCREEN3 24-Hour NO_x Conc. (µg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Deposition (µg/m3)
NO_x - NO3 Conversion		**10.0% Per Hour**		**SCREEN3 24-Hour Factor**		**0.25**			
West Elk Mine	11400	1.3	0.263	0	0.00	0.0000	0.0000	0.1249	0.00000
Oxbow Mine	13700	1.5	0.233	0	0.00	0.0000	0.0000	0.1482	0.00000
Bowie No. 2 Mine	18600	2.1	0.194	47	1.35	0.2625	0.0656	0.1957	0.01284
Haul Trucks	18600	2.1	0.194	6.5	0.19	0.0363	0.0091	0.1957	0.00178
Bowie Rail Facility	19450	2.2	0.189	11	0.32	0.0599	0.0150	0.2036	0.00305
RR Line 4	14300	1.6	0.227	0	0.00	0.0000	0.0000	0.1541	0.00000
RR Line 3	22900	2.5	0.173	14	0.40	0.697	0.0174	0.2352	0.00410
RR Line 2	34300	3.8	0.139	14	0.40	0.560	0.0140	0.3307	0.00463
RR Line 1	53800	6.0	0.109	14	0.40	0.0439	0.0110	0.4673	0.00513
NO_2 Available for Particulate Formulation				**107**		**0.528**	**0.132**		**0.0315**
Molar Ratio, Ammonium Nitrate to NO_2									1.74
Ammonium Nitrate Conc., µg/m3									0.031

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Table 3.1-15
B-Ext Increase at Mt. Gunnison
(Proposed Action - No-Action)

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN3 X/Q (μg/m3/g/sec)	Increased SO_2 Emissions, Proposed Project - No-Action (tpy)	SO_2 Emissions (g/s)	SCREEN3 1-Hr SO_2 Conc. (μg/m^3)	SCREEN3 24-Hour SO_2 Conc. (μg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Particles (μg/m3)
SO_2-SO_3 Conversion		1.0% Per Hour		SCREEN 3 24-Hour Factor		0.25			
West Elk Mine	11400	1.3	0.263	0	0.00	0.0000	0.0000	0.0126	0.00000
Oxbow Mine	13700	1.5	0.233	0	0.00	0.0000	0.0000	0.0152	0.00000
Bowie No. 2 Mine	18600	2.1	0.194	5	0.14	0.0279	0.0070	0.0206	0.00014
Haul Trucks	18600	2.1	0.194	4	0.12	0.0223	0.0056	0.0206	0.00011
Bowie Rail Facility	19450	2.2	0.189	0.5	0.01	0.0027	0.0007	0.0215	0.00001
RR Line 4	14300	1.6	0.227	0	0.00	0.0000	0.0000	0.0158	0.00000
RR Line 3	22900	2.5	0.173	0.8	0.02	0.0040	0.0010	0.0252	0.00003
RR Line 2	34300	3.8	0.139	0.8	0.02	0.0032	0.0008	0.0376	0.00003
RR Line 1	53800	6.0	0.109	0.8	0.02	0.0025	0.0006	0.0583	0.00004
SO_3 Available for Particulate Formation				12		0.063	0.0157		0.00036
Molar Ratio, Ammonium Sulfate to SO_2									2.06
Assumed Rel. Humidity									0.60
Humidity Correction Factor for Ammonium Sulfate									1.70
Ammonium Sulfate Concentration, μg/m3									0.00128

Table 3.1-15
B-Ext Increase at Mt. Gunnison
(Proposed Action - No-Action)

Source	Distance (m)	2.5 mps Plume Travel Time (hrs)	1-Hr SCREEN3 X/Q (µg/m3/g/sec)	Increased PM_{10} Emissions, Proposed Project - No-Action (tpy)	PM_{10} Emissions (g/s)	SCREEN3 1-Hr PM_{10} Conc. (µg/m^3)	SCREEN3 24-HR PM_{10} Conc. (µg/m^3)	Fractional Conversion at ___%/Hr Rate	Primary Particles (µg/m3)
Primary PM_{10} Conversion		**100.0% Per Hour**		**SCREEN3 24-Hr Factor**		**0.25**			
West Elk Mine	11400	1.3	0.263	0	0.00	0.0000	0.0000	1.0000	0.00000
Oxbow Mine	13700	1.5	0.233	0	0.00	0.0000	0.0000	1.0000	0.00000
Bowie No. 2 Mine	18600	2.1	0.194	98	2.82	0.5474	0.1369	1.0000	0.13685
Haul Trucks	18600	2.1	0.194	29	0.83	0.1620	0.0405	1.0000	0.04050
Bowie Rail Facility	19450	2.2	0.189	24	0.07	0.0131	0.0033	1.0000	0.00327
RR Line 4	14300	1.6	0.227	0	0.00	0.0000	0.0000	1.0000	0.00000
RR Line 3	22900	2.5	0.173	0.5	0.01	0.0025	0.0006	1.0000	0.00062
RR Line 2	34300	3.8	0.139	0.5	0.01	0.0020	0.0005	1.0000	0.00050
RR Line 1	53800	6.0	0.109	0.5	0.01	0.0016	0.0004	1.0000	0.00039
Primary Particulate				**131**		**0.729**	**0.182**		**0.1821**

Total Particulate at Receptor	
Primary PM_{10}	0.1821 µg/m3
Secondary Ammonium Nitrate	0.055 µg/m3
Secondary Ammonium Sulfate	0.00128 µg/m3

Table 3.1-15
B-Ext Increase at Mt. Gunnison
(Proposed Action - No-Action)

Total Particulate Increment	0.2383 μg/m3
IWAQM-1 B-ext Conversion Factor	0.0030
Incremental B-ext Increase	0.00071 1/km
Background Conditions	
Background Visual Range	200 km
Koschmeider bext	0.0196 1/km

Percent Increase in Extinction 5.30%

Wind Speed: 2.5 m/sec and D stability based on local wind data

Assumptions: SCREEN3 model was used, dividing the mine sites, haul roads, and railroad into 9 discrete point sources for modeling the concentration at West Elk.

SCREEN3 model assumed 2.5 m/sec wind speed based on the "cross-valley" average condition at the West Elk meteorological station.

NO_2 and SO_2 conversion rates were based on PLUVUE model, using the following: noon time, 70 degrees F, 60% humidity, 0.008 ppm ozone.

Table 3.1-16
B-Ext Increase, Black Canyon National Monument
(Proposed Action - No-Action)

Source	Distance (m)	3.6 mps Plume Travel Time (hrs)	1-Hr SCREEN3 X/Q (μg/m3/g/sec)	Increased NO_x Emissions, Proposed Project - No-Action (tpy)	NO_x Emissions (g/s)	SCREEN3 1-Hr NO_x Conc. (μg/m^3)	SCREEN3 24-Hour NO_x Conc. (μg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Deposition (μg/m3)
NO_x - NO3 Conversion		14.0% Per Hour		SCREEN3 24-Hour Factor			0.25		
West Elk Mine	40000	3.1	0.0635	0	0.00	0.0000	0.0000	0.3722	0.00000
Oxbow Mine	46000	2.4	0.060	0	0.00	0.0000	0.0000	0.3037	0.00000
Bowie No. 2 Mine	41000	3.2	0.0628	47	1.35	0.0850	0.0212	0.3794	0.00806
Haul Trucks	38900	3.0	0.0645	6.5	0.19	0.0121	0.0030	0.3641	0.00110
Bowie Rail Facility	36000	2.8	0.0672	11	0.32	0.0213	0.0053	0.3423	0.00182
RR Line 4	41200	3.2	0.0626	0	0.00	0.0000	0.0000	0.3809	0.00000
Rr Line 3	31400	2.4	0.0725	14	0.40	0.0292	0.0073	0.3061	0.00224
RR Line 2	25200	1.9	0.0821	14	0.40	0.0331	0.0083	0.2542	0.00210
RR Line 1	31400	2.4	0.0725	14	0.40	0.0292	0.0073	0.3061	0.00224
NO_2 Available for Particulate Formulation				107		0.210	0.052		0.0176
Molar Ratio Ammonium Nitrate to NO_2									1.74
Ammonium Nitrate Conc., μg/m3									0.031
Existing Baseline Deposition Rate at Sunlight Peak									5.2
Percent Increase Above Baseline									#REF1

Table 3.1-16
B-Ext Increase, Black Canyon National Monument
(Proposed Action - No-Action)

Source	Distance (m)	3.6 mps Plume Travel Time (hrs)	1-Hr SCREEN3 X/Q (μg/m3/g/sec)	Increased SO_2 Emissions, Proposed Project - No-Action (tpy)	SO_2 Emissions (g/s)	SCREEN3 1-Hr NO_x Conc. (μg/m^3)	SCREEN3 24-Hour SO_2 Conc. (μg/m^3)	Fractional Conversion at ___%/Hr Rate	Acid Gas Available for Particles (μg/m3)
SO_2-SO_3 Conversion		**1.5% Per Hour**		**SCREEN 3 24-Hour Factor**			**0.25**		
West Elk Mine	40000	3.1	0.0635	0	0.00	0.0000	0.0000	0.0456	0.0000
Oxbow Mine	44600	2.4	0.060	0	0.00	0.0000	0.0000	0.0356	0.0000
Bowie No. 2 Mine	41000	3.2	0.0628	5	0.14	0.0090	0.0023	0.0467	0.00011
Haul Trucks	36900	3.0	0.0645	4	0.12	0.0074	0.0019	0.0444	0.00008
Bowie Rail Facility	36000	2.8	0.0672	0.5	0.01	0.0010	0.0002	0.0411	0.00001
RR Line 4	41200	3.2	0.0626	0	0.00	0.0000	0.0000	0.0469	0.00000
RR Line 3	31400	2.4	0.0725	0.8	0.02	0.0017	0.0004	0.0360	0.00002
RR Line 2	25200	1.9	0.0821	0.8	0.02	0.0019	0.0005	0.0290	0.00001
RR Line 1	31400	2.4	0.0725	0.8	0.02	0.0017	0.0004	0.0360	0.00002
SO_3 Available for Particulate Formation				12		**0.023**	**0.0057**		**0.00024**
Molar Ratio, Ammonium Sulfate to SO_2									2.06
Assumed Rel. Humidity									0.60
Humidity Correction Factor for Ammonium Sulfate									1.70
Ammonium Sulfate Concentration, μg/m3									0.00085

Table 3.1-16
B-Ext Increase, Black Canyon National Monument
(Proposed Action - No-Action)

Source	Distance (m)	3.6 mps Plume Travel Time (hrs)	1-Hr SCREEN 3 X/Q (μg/m3/g/sec)	Increased PM10 Emissions, Proposed Project - No-Action (tpy)	PM10 Emissions (g/s)	SCREEN3 1-Hr PM10 Conc. (μg/m^3)	SCREEN3 24-HR PM10 Conc. (μg/m^3)	Fractional Conversion at ___%/Hr Rate	Primary Particles (μg/m3)
Primary PM10 Conversion		100.0% Per Hour		SCREEN3 24-Hr Factor		0.25			
West Elk Mine	40000	3.1	0.0635	0	0.00	0.0000	0.0000	1.0000	0.00000
Oxbow Mine	44600	2.4	0.060	0	0.00	0.0000	0.0000	1.0000	0.00000
Bowie No. 2 Mine	41000	3.2	0.0628	98	2.82	0.1772	0.0443	1.0000	0.044430
Haul Trucks	38900	3.0	0.0645	29	0.83	0.0539	0.0135	1.0000	0.01346
Bowie Rail Facility	36000	2.8	0.0672	2.4	0.07	0.0046	0.0012	1.0000	0.00116
RR Line 4	41200	3.2	0.0626	0	0.00	0.0000	0.0000	1.0000	0.00000
RR Line 3	31400	2.4	0.0725	0.5	0.01	0.0010	0.0003	1.0000	0.00026
RR Line 2	25200	1.9	0.0821	0.5	0.01	0.0012	0.0003	1.0000	0.00030
RR Line 1	31400	2.4	0.0725	0.5	0.01	0.0010	0.0003	1.0000	0.00026
Primary Particulate				131		0.239	0.060		0.0597

Total Particulate at Receptor	
Primary PM10	0.0597 μg/m3
Secondary Ammonium Nitrate	0.031 μg/m3
Secondary Ammonium Sulfate	0.00065 μg/m3

Table 3.1-16
B-Ext Increase, Black Canyon National Monument (Proposed Action - No-Action)

Total Particulate Increment	0.0911 μg/m3
IWAQM-1 B-ext Conversion Factor	0.0030
Incremental B-ext Increase	0.00027 1/km
Background Conditions	
Background Visual Range	200 km
Koschmeider b-ext	0.0196 1/km

Percent Increase in Extinction 1.40%

Wind Speed: 2.5 m/sec and D stability based on local wind data

Assumptions: SCREEN3 model was used, dividing the mine sites, haul roads, and railroad into 9 discrete point sources for modeling the concentration at West Elk.
SCREEN3 model assumed 2.5 m/sec wind speed based on the "cross-valley" average condition at the West Elk meteorological station.
NO_2 and SO_2 conversion rates were based on PLUVUE model, using the following: noon time, 70 degrees F, 60% humidity, 0.008 ppm ozone.

plume blight impact in this example would probably be limited to the section of plume immediately downwind of the mine. If the wind was blowing in a direction other than along the river valley it is expected that the distinct plume would remain intact for only a few miles before it dispersed over mountainous terrain.

For this assessment the observer was assumed to be on top of Mt. Gunnison, looking northwest toward the North Fork of the Gunnison River and the Bowie No. 2 Mine. Inspection of topographical maps indicates that the No. 2 Bowie Mine itself is probably hidden from view by Jumbo Mountain. However, it is conceivable that a ground-level plume blowing up the side of Jumbo Mountain could be visible from Mt. Gunnison.

EPA's PLUVUE visibility model (EPA, 1992) was used to evaluate plume blight for this viewing condition. PLUVUE is a relatively simple and conservative screening tool. PLUVUE uses Gaussian dispersion modeling of emissions from the source to the viewer based on a single wind speed and direction, with the same limitations as EPA's SCREEN3 model. PLUVUE models the downwind conversion of NO_x to particulate nitrate and SO_2 to particulate sulfate, which contribute to visibility impairment. PLUVUE allows the user to independently select the following source and viewer parameters:

- Orientation of the viewer relative to the emission source.
- Wind direction relative to the source and the viewer.
- Sun direction and sun height relative to the source and the viewer. For a given viewing angle, this allows the user to assess the impacts that would occur at different times of the day. For example, assume the viewer was looking westward at an important vista. Using PLUVUE the user could place the sun along the eastern horizon to simulate early morning conditions with the sun behind the viewer, or the user could place the sun along the western horizon to simulate late afternoon conditions with the sun in front of the viewer. Those two conditions are generally the most restrictive for visibility impairment. The most severe condition is when the viewer is looking in the direction of the emission source with the sun behind the source (in front of the viewer). In general, visibility impairment is minimized when the sun is high in the sky, so the sun is neither in front of nor behind the viewer.

For each selected modeling condition, PLUVUE quantifies the following visibility parameters:

Plume Contrast - Contrast is the difference in brightness between the plume and the background surface behind the plume. The perceived contrast depends on the color of the background surface (e.g., a dark background surface such as a forested hillside as opposed to a light background such as the sky). A contrast of 0.02 is barely perceptible. For purposes of quantifying visibility impairment, EPA defines "significant impact" as a plume contrast exceeding 0.05.

Plume Perceptibility Parameter E(L*a*b*) - This is a parameter that quantifies people's perception of a plume based on changes in visual qualities described as brightness (L*), color saturation (b*), and color changes (a*). Studies have shown that most people can detect a change in E(L*a*b*) of 1.0. For purposes of quantifying visibility impairment, EPA defines "significant impact" as a modeled E(L*a*b*) exceeding 2.0.

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The visibility impacts caused by incremental emission increases between "Action Alternative" and "No-Action Alternative" were assessed using PLUVUE, with the following assumptions:

Viewer Locations - As shown in *Figure 10, Emission Sources and Viewer for PLUVUE Modeling*, the viewer was placed on top of Mt. Gunnison at the northwest corner of the West Elk Wilderness, overlooking the North Fork of the Gunnison River valley.

Emission Sources – PLUVUE can model only a single emission source. To simulate mine-related emissions (mining dust, haul road emissions, and train loading emissions), a single "mine area source" was placed at the Bowie No. 2 Mine. The "mine source" included emission increases directly associated with the Bowie No. 2 Mine, coal trucks along State Highway 133, and the Bowie No. 1 Loadout. Emissions from the coal trains between Paonia and Delta were not included in the PLUVUE modeling. The following emission increases were used:

- 65.5 tpy of Nox
- 313 tpy of PM-10
- 9.5 tpy of SO2

Wind Direction – EPA's original visibility modeling protocol (EPA, 1988) specifies a wind direction that is 11.5 degrees away from the line connecting the source and the viewer. The resulting wind direction is shown in *Figure 10, Emission Sources and Viewer for PLUVUE Modeling*.

Wind Speed - Two wind conditions were modeled. The "average condition" was modeled at 3.6 meters per second and D stability based on the average value at the West Elk Mine meteorological station. A condition of 1.0 meters per second and F stability was used to simulate calm, stagnant conditions that might exist during early morning hours.

Viewing Angles – This assessment focused on plume blight within the first few miles of plume travel. Viewing angles ranging from directly at the mine source to cross-plume were considered. Viewing angles looking downwind at points more than 15 km from the source were not considered, because it is unreasonable to assume that the emissions from the mine would form a uniform, intact "plume" beyond 15 km downwind.

Sun Angle – Sun angles corresponding to July 4 were assumed. Three separate sun angles were run for each vista: 1 hour after sunrise with the sun near the northeast horizon; mid-day with the sun nearly overhead; and 1 hour before sunset with the sun near the northwest horizon.

Wind Speed and Stability - Two wind conditions were modeled. The "average condition" was modeled at 3.6 meters per second and D stability based on the average value at the West Elk Mine meteorological station. A condition of 1.0 meters per second and F stability was used to simulate calm, stagnant conditions that might exist during early morning hours. The "F stability" condition is unlikely to occur in the afternoon at the Paonia area, because ground heating during the day prevents the occurrence of strong temperature inversions that produce stable conditions.

Background Visual Range – The modeling assumes a clear, warm day with low background pollutant concentrations. The background visual range is 290 km, which is the 90th percentile clearest value at the West Elk Wilderness.

The results of the PLUVUE runs are listed in *Table 3.1-17, Summary of PLUVUE Results*. A significant impact is defined as E(L*a*b*) exceeding 2.0 or Contrast exceeding 0.05. The results were as follows:

- The maximum impact occurs near sunset, when the sun is northwest behind the source. The modeled impacts at mid-day and sunrise are lower.
- For the "average wind condition" of 3.6 meters per second and D stability, the modeled E(L*a*b*) and Contrast at all viewing angles and times of day are less than the thresholds defining a significant impact.
- For the "F stability condition" where the viewer is looking almost directly at the mine at sunset with the sun behind the mine, the E(L*a*b*) and Contrast exceed the criteria for an EPA significant impact. However, F stability does not occur in the afternoon on sunny days, so it is unreasonable to assume that the Mt. Gunnison viewer would ever be subjected to this condition.

3.1.3.6 Effects of Alternatives C and D

Air quality impacts resulting rom Alternatives C and D would be the same as described in Section 3.1.3.4, Effects of Alternative B Including Cumulative Impacts, except the effects would be extended given the duration of operations expected in Alternatives C and D.

3.1.4 Possible Mitigation and Monitoring

Based on the predicted air quality impacts for the action alternatives, the following air quality mitigations are suggested:

- Colorado APCD will continue to enforce the emission controls, emission monitoring, and emission reporting that are specified in the APEN air quality permits for any mining operations that extract coal from the Iron Point and Elk Creek Coal Lease Tracts.
- EPA and Colorado APCD will continue to enforce the emission standards for diesel locomotives and diesel off-road equipment that have recently been enacted by EPA.

3.2 TOPOGRAPHY/PHYSIOGRAPHY

Issue: *Identify the potential for subsidence by underground mining activities.*

3.2.1 Introduction

The analysis area encompasses the lands within and immediately surrounding the exploration license area and the coal lease tracts. Topography of the general area ranges from steep to relatively flat. Elevations range from slightly over 5,600 feet in the North Fork of the Gunnison River Valley near the town of Paonia to elevations over 10,000 feet in the mountains surrounding the exploration license and lease tract areas.

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Table 3.1-17
Summary of PLUVUE Results

Viewing Direction	Early am (6:40)		Noon		6:40 pm		Early Evening (7:40 pm)	
	E(L*a*b*)	Contrast	E(L*a*b*)	Contrast	E(L*a*b*)	Contrast	E(L*a*b*)	Contrast
Worst-Case Wind Condition 1.0 mps and F Stability								
NW, almost directly toward mine	0.76	0.014	0.89	0.035	**2.6**	**0.083**	**5.57**	**0.11**
Cross-plume, WSW toward Delta	0.42	0.001	0.106	0.002	0.87	0.005	0.61	0.007
Average Wind Condition at West Elk Mine and Grand Junction NWS Station: 3.6 mps and D Stability								
NW, almost directly toward mine	0.55	0.004	0.22	0.009	0.99	0.019	1.42	0.041
Cross-plume, WSW toward Delta	0.54	0.003	0.084	0.001	0.98	0.004	0.41	0.002
Impacted Viewing Angles for Worst-Case Meteorology (1.0 m/sec and D Stability)								
Sunrise	None							
Mid-day	None							
Sunset	Closer than 20° toward mine							
Impacted viewing Angles for Average Meteorology (3.6 m/sec and D Stability)								
Sunrise	None							
Mid-day	None							
Sunset	None							

Source:	Mine Area Centered at Bowie No. 2
Viewer:	Top of Mt. Gunnison at NW corner of West Elk Wilderness
Wind Conditions:	Blowing from mine in a direct 11.5° southwest of the viewer
Background Visual Range:	292 km (annual 90th percentile)
Emissions:	Emission Increase in the Paonia-Somerset Area, Proposed Action - No-Action Nox 65.5 tpy PM 131 tpy SO_2 9.5 tpy

Impact Thresholds

E(L*a*b*): Perceptible at 1.0, significant impact at 2.0
Contrast: Perceptible at 0.02, significant impact at 0.05

3.2.2 Affected Environment

The elevations in the Iron Point Exploration License area range from about 6,400 feet in the Hubbard Creek drainage and 7,500 feet in the Terror Creek drainage to over 8,400 feet in an area west of Terror Creek Reservoir. The exploration license area is drained by both Terror Creek and Hubbard Creek. These drainages flow in a general north-south orientation and empty into the North Fork of the Gunnison River Valley.

The elevations in the Iron Point Coal Lease Tract range from approximately 6,400 feet in the Hubbard Creek drainage and 6,800 feet in the Terror Creek drainage to over 8,200 feet on the upper reaches of the lease tract. The Iron Point Coal Lease Tract is drained by Terror Creek and Hubbard Creek. These drainages flow in a general north-south orientation and empty into the North Fork of the Gunnison River Valley.

The elevations in the Elk Creek Coal Lease Tract range from about 6,400 feet in the Hubbard Creek drainage and 6,700 feet in the Bear Creek drainage to over 8,500 feet in the upper reaches of the tract. The Elk Creek Coal Lease Tract is drained by Hubbard Creek, Bear Creek, and Elk Creek. These drainages flow in a general north-south orientation and empty into the North Fork of the Gunnison River.

The topography of the area has also been greatly influenced by a wide range of mass-movement landforms and processes within the North Fork of the Gunnison River Valley, including localized natural landslides and rock falls in the Hubbard Creek drainage. Landsliding in this region is usually preceded, accompanied, and followed by perceptible creep along the surface of sliding or within the slide mass. Landslides, rock falls, and other areas of general geologic/topographic instability are shown on *Figure 11, Geologic Hazards Map*.

3.2.3 Environmental Consequences

3.2.3.1 Summary

The actual leasing of the Iron Point and Elk Creek Coal Lease Tracts would impose no topographic change on the tracts. Similarly, the exploration activities as proposed for the Iron Point Exploration License area would have no noticeable topographic impact.

If the tracts are leased subsequent underground longwall mining would cause subsidence as discussed in *Appendix F, Overview of Underground Coal Mining*, and *Appendix K, Subsidence Evaluation*. Subsidence would be most notable on ridges and steeper slopes, particularly cliffs, where cracks might open on the order of a few inches to possibly 1-foot wide and 25 to 50 feet deep. Fewer cracks would occur in the valleys than on ridges, because the valleys are more stable and the alluvial material found in the valleys tends to be more yieldable than some of the brittle bedrock found on the ridges. Subsidence from longwall mining could aggravate the movement of existing landslides and rock falls.

3.2.3.2 Effects of Alternative A (No-Action)

If the No-Action Alternative is selected, there would be no exploration activities in the Iron Point Exploration License area, and no mining activities would occur in either the Iron Point or the Elk Creek Coal Lease Tracts. Thus, there would be no topographic changes as a result of such activities. Natural landsliding and rock falls would continue, particularly in the Hubbard Creek drainage given its existing, natural geologic instability.

3.2.3.3 Effects Common to All Action Alternatives

Subsidence amounts and processes regarding longwall mining are discussed in a general manner in *Appendix F, Overview of Underground Coal Mining*, and in *Appendix K, Subsidence Evaluation*. Subsidence does occur in areas above longwall mining. The amount of subsidence above longwall mining depends on many factors including the mine plans, the coal thickness, the geologic strata, and the overburden depth. As a general rule, the greater the overburden thickness, the less the surface subsidence. For example, assuming a coal extraction thickness of 12 feet for the D seam in the Elk Creek Coal Lease Tract, surface subsidence would be expected to be 7 to 8 feet for those areas with 500 feet of overburden. At overburden depths of 2,000 to 2,500 feet, surface subsidence would be projected between 1 and 3 feet. The subsidence over the gate roads (entries on either side of a longwall panel) is typically 1 to 2 feet less than the panel itself.

Topographic changes caused by subsidence under longwall mining are often unnoticeable to the untrained eye. As longwall mining proceeds under a particular area, there would be some cracking on the surface. As mining proceeds away from the area, this surface cracking tends to disappear, although the elevation of the area would be lower. In certain areas, such as the alluvial material in drainage areas, the alluvium may be stretched but will not rupture when mine subsidence occurs.

Subsidence at any given point on the surface begins when the longwall face is beneath that point and is generally 90 percent complete when the longwall face has passed at 1.2 to 1.4 times the overburden depth beyond the point of mining. For example, at 500 foot depth of overburden, the subsidence beneath longwall mining would be 90 percent complete within about a month when the longwall face is 600 to 700 feet beyond that point on the surface. Other than lowering the land surface, the long-term effects of subsidence on surface topography would be minimal, and even unnoticeable to most casual observers. Some residual cracks may remain in the more brittle bedrock material on ridges or cliffs, but overall, the topography above subsided longwall mining workings would be similar to the pre-mining topography, albeit lower in elevation.

Subsidence from underground mining could aggravate, and perhaps even accelerate, the existing landslides and rock falls in the area, particularly those geologic hazards that occur in an area where the overburden depth is less than 500 feet. Other natural factors may cause an acceleration of impacts, these factors being separate from subsidence. For example, in an extremely wet spring, the moisture from snowmelt and spring rains could cause these natural landslides and rock falls to move and shift. This seems to have been the case in the mid 1980s, during a period of intense precipitation and moisture. It is difficult to assess whether the naturally occurring landslide and other unstable areas have been aggravated by subsidence.

There are no anticipated indirect long-term topographic impacts expected for the surface utilized for underground mining activities. These areas would be regraded and recontoured following mining closure and removal of structures in such a manner that the area would blend into the surrounding undisturbed terrain. See Section 2.7, Reclamation Measures.

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3.2.3.4 Effects of Alternative B

Only minor direct surface disturbances would be associated with the exploration (roads, drill sites) and potential mining of the two coal lease tracts (roads, ventilation raises, and degasification borehole pads). Such direct surface disturbance activities would not affect the topography of the area, and any surface disturbing activities would be reclaimed as set forth in Section 2.7, Reclamation Measures.

As explained in both *Appendix F, Overview of Underground Coal Mining*, and *Appendix K, Subsidence Evaluation*, there is a potential for surface subsidence as a result of longwall mining. The amount of subsidence would depend on the overburden depth, but it would be relatively uniform across the topography and would not leave irregularly shaped depressions on the surface. Rather, the subsidence would be relatively uniform (i.e., the change in elevation due to subsidence would be essentially the same across each tract). On the fringes of the subsidence, some tension cracks may be visible, but they may heal with time. Some cracks, especially in bedrock never heal.

3.2.3.5 Effects of Alternative C

The impacts of Alternative C would be similar to those described Section 3.2.3.2, Effects Common to All Alternatives, and Section 3.2.3.4, Effects of Alternative B (Proposed Action). The exception with Alternative C would be that the amount of subsidence anticipated with multiple-seam mining would be greater than that of single seam longwall mining. An estimated maximum average subsidence for extraction of both the D and B coal seams would be 13 feet. See *Appendix K, Subsidence Evaluation*, for further information.

3.2.3.6 Effects of Alternative D

The impacts of alternative D would be similar to those of Alternative C, except extra precautions (barrier pillars, buffer zones, etc.) would be taken to prevent any subsidence in the Terror Creek and Hubbard Creek drainages, and beneath the Curecanti-Rifle 230/345 kV electric transmission line which is located in the Terror Creek drainage.

3.2.4 Possible Mitigation and Monitoring

No additional mitigation and monitoring measures are suggested. Subsidence monitoring is a requirement of the mine permit issued by the Colorado Division of Minerals and Geology (DMG). If surface cracks occur that affect other uses (roads, trails, etc.), the surface management agencies have authority to require timely on-site mitigation.

3.3 GEOLOGY

***Issue:** Identify geologic hazards on the lease sites and the potential for subsidence by underground mining activities. Areas of concern include the potential influence of geologic hazards; the potential for and consequences of subsidence; the effects of mining on the area's geology, including seismicity.*

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3.3.1 Introduction

The characteristics of a coal deposit dictate the most economical and practical mining application. See *Appendix E, Mining Economics*. Geologic data and the interpretations form the basis for mine evaluation and mine production by providing coal reserve estimates and geologic structure data (such as dip, faults, fracture patterns, etc.). For underground mining operations, geologic information is used to assess subsidence.

3.3.2 Affected Environment

3.3.2.1 General Geology

The Iron Point Exploration License area, and the Iron Point and Elk Creek Coal Lease Tracts, lie in the Paonia-Somerset coal field which contains medium to high coal development potential deposits. The main coal beds within this area are found in the Upper Cretaceous Mesa Verde Formation, which is overlain by the Tertiary Wasatch formation and underlain by the Upper Cretaceous Mancos Shale. See *Figure 12, Typical Geologic Cross-Section*.

In addition to the sedimentary units in the region, isolated igneous intrusions have been encountered. Iron Point, located in Section 27, T12S, R91W, is an example of an igneous intrusion. Preliminary geologic data indicates that another intrusion may have compromised the coal in the northwest portion of the Iron Point Coal Lease Tract.

The coal bearing sedimentary strata of the Mesa Verde Formation are relatively flat lying with a regional dip of approximately five degrees to the north/northeast. Local dips can vary.

The principal mineable coal seams on the Iron Point Coal Lease Tract are the "D" seam and the "B" seam. Other seams within the tract, A, C, and E, are either considered too thin (less than 6 feet) or are too discontinuous to mine. In the case of the "B" seam, there has been historic mining of this seam on the Iron Point Tract.

The primary mineable coal seam on the Elk Creek Coal Lease Tract is the "D" seam. On this tract, the A and E coal seams are either considered too thin (less than 6 feet) or are too discontinuous to mine. The B and C coal seams on the Elk Creek Tract were historically mined.

The overburden overlying the D seam in the Iron Point Coal Lease Tract is generally greater than 500 feet, with the exception of areas under and immediately adjacent to Hubbard Creek. In the northern part of the tract, overburden over the D seam is typically over 1,500 feet. The D seam is over 2,000 feet beneath the Terror Creek Reservoir. See *Figure 13, D Seam Overburden Isopach*. Overburden underlying Terror Creek ranges from 500 to 1,200 feet.

The overburden overlying the D seam in the Elk Creek Coal Lease Tract is typically greater than 500 feet and reaches over 2,500 feet at the northeastern boundary of the tract. See *Figure 13, D Seam Overburden Isopach*.

Outcropping on both the Iron Point and Elk Creek Coal Lease Tracts are the Tertiary Wasatch Formation, Upper Cretaceous Mesa Verde Formation, and Quaternary deposits. The Cretaceous Mancos Shale does not outcrop on the lease tracts but lies below the Mesa Verde Formation. The following is a brief overview of the geologic units in the area:

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- **Quaternary Deposits:** The Quaternary deposits are an unsorted mixture of soil and rock formed by various mass-wasting processes such as landslides, earth flows, soil creep, and debris avalanches. These deposits also include slope colluvium and Quaternary unconsolidated deposits derived from the Wasatch Formation.

- **Wasatch Formation (Tertiary):** The Wasatch formation overlies the Mesa Verde Formation. It consists of red and buff shales and red sandstones in the upper part of the formation, and red to gray conglomerates in the lower portion. The Ohio Creek conglomerate, which is the basil conglomerate unit, is a regional marker and commonly referenced geologic mapping datum.

- **Mesa Verde Formation (Cretaceous):** The Mesa Verde Formation is the primary coal bearing formation in this region and conformably overlies the Mancos Shale Formation. It consists of approximately 2,300 feet of interbedded coal seams, sandstones, shales, and siltstones. The Mesa Verde Formation consists of the Barren Member, Paonia Member, Bowie Member, and Rollins Sandstone Member. The Barren Member is approximately 1,600 feet in thickness and contains no coal seams. The Paonia Member ranges from approximately 300 to 500 feet and is composed of shales and interbedded sandstone. The Paonia Member contains the D and E coal seams. The Bowie Member ranges from 270 to 350 feet thick and consists primarily of grey shales, interbedded lenticular sandstones, and coal seams. The Bowie Member contains the A, B, and C coal seams. The Rollins Sandstone ranges from 120 to 200 feet in thickness, and it is a massive, cross-bedded medium to coarse grained, buff to white sandstone unit. The Rollins Sandstone lies conformably on the underlying Mancos Shale and is relatively continuous throughout the area, thus serving as a common marker bed.

- **Mancos Shale (Cretaceous):** The Mancos Shale is a regionally extensive bed of marine shales ranging up to 4,000 feet in thickness. In the lease tracts, it underlies the exposed geologic sequence. However, west of the town of Somerset, the North Fork of the Gunnison River has cut through the upper portion of the Mancos Shale, exposing the grey marine shales so prominent with this formation.

A northwest trending fault may be present in the Iron Point Coal Lease Tract. Other undetected faults may also occur.

3.3.2.2 Geologic Hazards

As discussed in Section 3.2, Topography/Physiography, the area within and surrounding the Iron Point Exploration License area and the two coal lease tracts, have numerous existing natural landslide areas and other unstable slopes. See *Figure 11, Geologic Hazards Map*.

The geologic hazards have been mapped in accordance with state of Colorado House Bill 1041 (C.R.S. 1973, 24-65.1-101, *et. seq.*). As defined in House Bill 1041, a geologic hazard means "a geologic phenomenon which is so adverse to past, current, or foreseeable construction or land use as to constitute a significant hazard to public health and safety or to property." House Bill 1041 also points out that geologic hazards, which are a normal dynamic process, can be intensified or lessened by human activity. In any event, regardless of the intensity, hazards should be recognized and considered prior to any land use changes.

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Most of the geologic hazards observed in the exploration license area and coal lease tracts are historic in nature. However, during periods of high to very high precipitation in the mid 1980s, there was renewed movement of existing landslides and the development of new landslides in unstable slopes. Such areas of recent movement have been identified on *Figure 11, Geologic Hazards Map*.

3.3.2.3 Other Geologic Resources

The potential for the discovery of conventional resources of oil and gas under the Iron Point and Elk Creek Coal Lease Tracts appears to be very slight. Dry wells have been drilled to the Dakota Sandstone a few miles to the southwest and to the northwest of the lease tract areas. There are no oil and gas leases located on or near the exploration license area or the lease application tracts. Methane is found in the coal seams and is released with mining to the surface for the safety of the mining operation. Other coal seams in the project area are not considered economically recoverable.

3.3.3 Environmental Consequences

3.3.3.1 Summary

There would be negligible effect to the geologic resources as a result of drilling activities in the exploration license area.

If leasing and mining proceeds on the Iron Point and Elk Creek Coal Lease Tracts, coal would be removed, and the overlying overburden material would be altered through subsidence. The coal would be extracted, and the existing geologic structure and lithologic continuity in the area above the mined coal would be altered by subsidence. See *Appendix F, Overview of Underground Coal* Mining and *Appendix K, Subsidence Evaluation*.

Indirect Effects - There are no indirect geologic effects expected for any of the alternatives. No effects to the Terror Creek Reservoir would occur because the leaks would not be offered. See *Appendix K. Subsidence Evaluation*.

Cumulative Effects - A considerable amount of the area in the North Fork of the Gunnison River Valley near Somerset has been mined by historic mining activities. See *Appendix G, Historic Coal Mining Activity*. There has been subsidence in a number of the areas above the historic mining; however, there has been no known damage to resources or overlying structures attributable to this subsidence. In some cases, near the coal subcrop areas, where overburden material is minimal, subsidence may have contributed or aggravated landslide movements, but this determination is difficult to quantify given the natural (pre-mining) geologic instability in many areas in the North Fork of the Gunnison River Valley.

3.3.3.2 Effects of Alternative A (No-Action)

If the No-Action Alternative is selected, coal would not be disturbed by exploration and would not be mined in the lease tracts. The coal resource and the structural and lithologic integrity of the Iron Point and Elk Creek Coal Lease Tracts would remain in-place. The potential to recover the coal resource at some time in the future would remain.

3.3.3.3 Effects Common to All Action Alternatives

Direct Effects - In all alternatives, coal would be mined by longwall techniques. After coal recovery, the overburden would be altered due to subsidence. See *Appendix K, Subsidence Evaluation*. Subsidence would occur due to the extraction of coal on retreat from the longwall panels. There would be a gradual lowering of the surface after the longwall shearer removes the coal. Some cracking would be evident as the shearer passes, and along the fringes of the extracted panel. However, due to the thickness of the overburden in the two lease tracts, it is anticipated that subsidence would not be easily evidenced to casual observers. Rock falls at the outcrop could occur, but the historic (pre-mining) burning of the coal along the outcrop (causing the reddish coloration in the strata in the valley) would preclude a significant amount of mining close to the outcrop; therefore, rock falls induced by subsidence would be unlikely. There is a potential that mining subsidence could aggravate existing landslides and other geologic hazards in the Hubbard Creek drainage. See *Figure 11, Geologic Hazards Map*.

The relative potential of mine subsidence is graphically illustrated on *Figure 14, Subsidence Potential Map*. This map represents a compilation of the overburden depth to the D coal seam in relation to the geologic hazards of the area, as shown on *Figure 11, Geologic Hazards Map*. Typically, those areas showing "high to very high" subsidence potential are those regions under 500 feet of overburden cover to the coal seam combined with areas that presently exhibit landslide, rock falls, or other geologically unstable stratum. The potential impacts are lessened with the depth of overburden, with potential subsidence impacts of "low to very low" being typically those areas greater than 1,500 feet of overburden depth to the coal seam. The impact zones shown on *Figure 14, Subsidence Potential Map*, are based on conservative assumptions, and the actual impacts may be less than suggested on the map.

The duration of subsidence resulting from mining is composed of both an active and residual phase. Active subsidence refers to movements occurring simultaneously with the mining operations, while residual subsidence is that part of the surface deformation that occurs following the cessation of mining.

Time spans during which surface subsidence may occur vary with the mining method being used. Longwall mining induces subsidence rapidly, beginning almost immediately after mining. With room and pillar mining, major occurrences of surface subsidence may be delayed for decades until the support pillars have substantially deteriorated and collapsed. See *Appendix F, Overview of Underground Coal Mining*.

The duration of residual subsidence movements above longwall panels is relatively short, typically varying from a few weeks up to ten years. On the other hand, in room and pillar mining, without pillar recovery, the magnitude of active subsidence is generally small, and the ground surface may experience a variable frequency of subsidence incidents during this pillar period. Sometime after room and pillar mining, however, complete collapse of abandoned pillars in the adjacent strata may occur as a result of natural causes or human activities. These processes are likely to continue until all the voids created by mining excavation have been filled by caved stratum. Consequently, in the case of room and pillar mining, the residual subsidence can result in major subsidence measured on the surface.

Residual subsidence from historic room and pillar mining has and will continue to create mining induced seismic events in the area. For example, seismic events from the now abandoned

Somerset Mine have been measured on the Richter Scale at the U.S. Geological Survey (USGS) Earthquake Center in Golden, Colorado. See *Appendix K, Subsidence Evaluation*.

Mining induced seismic events as a result of longwall mining would be minimal. These events should not inflict any damage to surface resources or overlying structures. It is not likely that any low energy seismic events as a result of longwall subsidence would cause damage to any existing structures in the area, structures such as the Curecanti-Rifle 230/345 kV electric transmission line or the Terror Creek Reservoir impoundment structures.

3.3.3.4 Effects of Alternative B

The effects of Alternative B would be the same as those described in Section 3.3.3.3, Effects Common to All Action Alternatives.

3.3.3.5 Effects of Alternative C

The impacts of Alternative C would be similar to those described in Section 3.3.3.2, Effects Common to All Alternatives, with the exception that the amount of subsidence anticipated with multiple seam mining of the Iron Point Coal Lease Tract would be slightly greater than those of Alternative B. Even with multiple seam mining, the subsidence should be fairly uniform over the entire lease tract. Overburden deformation (i.e., fracturing) can migrate further into the overburden with multiple seam coal mining. See *Appendix K, Subsidence Evaluation*.

3.3.3.6 Effects of Alternative D

Effects would be similar to Alternative C, except that special subsidence protection (i.e., barrier pillars, buffer zones, etc.) would be required for those areas under and immediately adjacent to Hubbard Creek, Terror Creek, and the Curecanti-Rifle 230/345 kV electric transmission line.

3.3.4 Possible Mitigation and Monitoring

Subsidence monitoring programs acceptable to the Colorado DMG would be implemented for both coal lease tracts. No other monitoring is recommended.

3.4 SOILS

Issue: *Identify and protect soil resources for future reclamation uses. Provide for reclamation of areas disturbed by surface facilities.*

3.4.1 Introduction

Soils information and technical data were taken from two soil surveys completed for the project area. An Order III soil survey, entitled Soil Survey of Grand Mesa-West Elk Area (Cryer and Hughes, 1997) was used to characterize and describe the soils overlying that portion of the project area administered by the Forest Service. A soil survey completed by the Natural Resources Conservation Service (formerly the Soil Conservation Service) entitled Soil Survey of Paonia Area, Colorado (Hunter 1981) was obtained and used to describe and characterize the soils overlying the privately held and BLM-administered lands within the project area boundary. These surveys each contain soil maps depicting the areal extent of the soils mapped as well as map unit descriptions, typical pedon descriptions, and interpretation tables which were used to develop the text presented below. These two soil surveys were not correlated, and the map unit boundaries merging along federal and private land boundaries do not necessarily meet. No site-specific soil baseline studies were conducted for the coal lease or exploration license areas as a part of this project nor are any other relevant soil reports known to exist which could provide applicable soils baseline information.

3.4.2 Affected Environment

3.4.2.1 General Soil Properties

A total of 32 soil map units, characterized by 38 soil series, families or miscellaneous groupings, were delineated within the project area. These soils are forming in response to the wide variety of parent materials, elevations, slopes, aspects, and rates of material weathering common to the project area as a whole. Consequently, these soils exhibit a wide variety of characteristics in terms of soil properties and use interpretations. *Figure 15, Soil Map*, depicts the 32 soil map units delineated.

Soils overlying mountain side slopes and toe slopes are developing in residuum and colluvium from sandstone and shale sources, as well as from some mixed alluvium parent materials. These soils occur on slopes typically ranging from 20 to 70 percent and are primarily deep to very deep, well drained, and have moderate to high available water capacities. Soil textures are highly variable ranging from loams to very stony clays for surface soils and from loams to very cobbly clays for subsurface soil horizons. Coarse fragment percentages increase with depth. The mass movement potential is rated as moderate to high for most of these map units, though low ratings are common for lesser slope angles.

Soils of canyon, mesa, ridge, mountain, and valley side slopes are highly variable given the broad topographic range of this grouping. Parent materials include interbedded sandstones, shales, and mixed igneous rock types. Slopes range from 5 to 90 percent. These soils are shallow to very deep, well drained, and typically exhibit low to medium available water capacities. Surface textures range from clay loams to extremely stony loams while subsurface textures range from stoney sandy loams to very cobbly clays. The mass movement potential is low to high given the broad slope range.

Deep, well-drained soils with moderate to high available water capacities overlie the fans and associated landforms of the project area. Alluvium and landslide materials from mixed rock sources are the dominant parent materials. Slopes range from nearly level to 40 percent with lesser slopes predominating. Soil textures range from loams to stony loams for surface soils and from clays to extremely cobbly loamy sands for subsurface soil horizons. The mass movement potential is rated as low to medium.

Rock outcrops occur across the project area and are expressed as bare rock exposures of canyon walls, escarpments, and very steep upland side slopes. Little in the way of soil is included in these map units.

3.4.2.2 Soil Salvage and Reclamation Suitability

Soil salvage depths were selected considering the limited disturbances proposed, and assuming that for the majority of disturbed unsalvaged subsoils would remain in place and would be available as a subgrade growth medium following facility decommissioning. Map unit

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slopes were not considered since the range of slopes within a map unit often includes slope angles both accessible and inaccessible to salvage equipment.

The soils overlying the project area exhibit a comparatively narrow range of characteristics with respect to salvage suitability. Proposed total salvage depths typically range from 10 to 24 inches and include both surface and subsurface soil materials. The main constraints to deeper soil salvage across the coal lease and exploration license areas relate to physical soil characteristics and include high subsoil coarse fragment content (>35 % by volume) and high clay content (clay textures). Low pH values (<6.0) and shallow depths to bedrock also constrain salvage depth for a number of map units.

The in-place reclamation suitability of the soil map units of the lease areas range from low to high given typical soil characteristics and the slope angles upon which the soils are present. Soil chemical characteristics are not normally limiting with respect to reclamation suitability. Soil physical characteristics such as surface stones, slow permeability, clayey textures, and low available water capacity limit the suitability of several units. Topographic and related factors such as slope and erosion potential, respectively, also limit the suitability of many of the coal lease tracts and exploration license area map units.

3.4.2.3 Erosion Hazard

Erosion hazard of the soils present is highly variable. Generally, as slope increases, water erosion hazard increases. Map units having slopes of approximately 25 percent or less typically have a low or medium hazard, while steeper slopes have medium to high hazards. Rock outcrops and rubble areas also have low water erosion hazard ratings. The hazard of wind erosion is slight for the vast majority of these map units.

3.4.3 Environmental Consequences

3.4.3.1 Summary

Approximately 33.5 acres (see Section 2.4, Alternative B) would be directly impacted by the construction of various boreholes, shafts, light-use access roads, and drill pads associated with surface activities and exploration. These soils, given the variability of the project area in terms of parent materials, slope, aspect, etc., are highly variable in and of themselves with respect to chemical and physical characteristics. Suitable salvage depths are comparatively shallow with deeper salvage typically constrained by high coarse fragment contents and heavy clay textures.

Direct impacts to soils include the salvage and stockpiling of selected surface soils for later re-application, compaction, and erosion. Given the size and form of the individual facilities making up the proposed disturbed acreage, as well as the regulatory requirements for revegetation, the direct impacts to soils are limited and considered to be short-term and mitigable. The sole indirect impact to soils, potential subsidence-induced cracking, would have a limited surface impact on the soil resource. Soil cracks tend to heal naturally, and represent a short-term disturbance. The proposed disturbance of 33.5 acres represents an increase of 10 percent over the acreage of soils disturbed by coal operation in the project area to date, and less than 1 percent of the acreage included in the lease tracts and exploration license area as a whole.

3.4.3.2 Effects of Alternative A (No-Action)

Under the No-Action Alternative, the project area would essentially remain in its endemic state supporting current land uses. No direct or indirect affects associated with the reasonable foreseeable actions listed for either lease area or the exploration area are anticipated. Future impacts to soils would parallel historic impacts barring any unforeseen future developments or changes in grazing or timber harvesting policies.

3.4.3.3 Direct Effects Common to All Action Alternatives

Direct impacts to soils under all alternatives would result from the development of exploration and degasification boreholes, exhaust and ventilation shafts, and construction of any necessary spur roads to access these facilities. A total of 33.5 acres of surface soils, at a maximum, would be affected by these actions as depicted in *Table 3.4-1, Acreage of Potential Disturbance by Facility Type-All Alternatives*.

Table 3.4-1
Acreage of Potential Disturbance by Facility Type - All Alternatives

Proposed Lease Element	Exploration Boreholes	Degasification Boreholes	Exhaust Shafts	Ventilation Shafts	Roads
Iron Point Exploration Area	6.5*	NA	NA	NA	5.0
Iron Point Lease Area	NA	2.0	3.0	NA	5.0
Elk Creek Lease Area	NA	4.0	NA	1.0	7.0
Totals	**6.5**	**6.0**	**3.0**	**1.0**	**17.0**

* Includes five holes that are within the potential boundary of the Iron Point Coal Lease Tract.

Impacts to the soil resource include those which would affect the chemical, physical, and microbial nature of endemic soil materials. Erosion is a potential impact which must also be considered. Soil chemical parameters would be permanently modified as a result of any soil salvage program whereby surface soils would be stockpiled or wind-rowed along the borders of areas to be disturbed by various shafts, boreholes, and road construction. Surface soil horizons would be mixed during stockpiling or windrowing resulting in a blending of characteristics as compared to the soils in their natural state. Soil chemistry would also be modified through stockpiling as anaerobic conditions within the stockpiles would develop. The volume of soil to be stockpiled would be limited, and the time the soils would exist in such stockpiles would be comparatively short for most disturbances. Therefore, changes in soil chemistry due to this activity are considered to be short-term and redeemable to a level commensurate with vegetation establishment following resoiling.

Isolated spill accidents, should they occur, could result in minor soil contamination from oils, solvents, etc. Soils so affected can be buried to effectively reduce the effects of this impact. The volume of soil subject to spills should be limited, however, given the plan to stockpile suitable surface soils prior to operational disturbances. No impact to revegetation potential is anticipated.

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A number of soil physical characteristics such as structure, texture, and rock fragment content would be permanently modified through blending during stockpiling and soil replacement operations. Given that only suitable soils would be salvaged, this is not considered to be a negative impact. Compaction in heavily trafficked operational areas would likely reduce the aeration, permeability, and water-holding capacity of impacted soils. Ripping and similar surface manipulations are proposed as a part of the reclamation plan to address compaction concerns. The effects of compaction would be reduced to a short-term impact through the proper application of such techniques, and natural freeze-thaw cycles, over time.

Soil microbial and fungal populations could also change resulting in a potential loss of nitrifying bacteria and mycorrhizal species due to stockpiling. Microbe and fungal populations should re-establish over time, typically through natural invasion via wind, drainage water, and animal vectors from nearby adjacent undisturbed areas. This is a generally accepted premise in the west based on observations of previously mined and reclaimed areas where stockpiled soil has been respread and revegetation has been successful. It is particularly true for these proposed disturbances given their limited individual sizes and, in the case of roads, a linear form. This is considered to be a short-term, mitigable impact with no reduction in reclamation potential expected.

Wind erosion is not expected to occur on exposed areas where salvageable soil has been removed. The potential for wind erosion on the project area is low due to the surrounding topography, comparatively dense endemic vegetation communities, and the surface soil rock fragment content. It may also be noted that the expected disturbances are comparatively small and narrow, a condition not conducive to the forces of wind erosion. In addition, temporary soil stockpiles would be stabilized following stockpiling operations and all disturbed areas would be revegetated following decommissioning.

The potential for soil erosion by water ranges from "low" to "high" across the soils of the coal lease tracts and exploration license area. Grading to permit facility construction would typically occur on slopes less than 40 percent and result in nearly level construction areas having comparatively short slope lengths. Such conditions result in a low short-term potential for water erosion for any soils impacted by various shafts and boreholes. Construction of spur roads to shaft and drill pad areas would also result in a low short-term erosion potential for these same reasons. All disturbances of this nature must be reclaimed per state and federal regulations following decommissioning. The small acreages and short slopes involved, coupled with required soil salvage, result in a moderate to high revegetation potential for any surface disturbances.

3.4.3.4 Effects of Alternative B

Other than the direct affects discussed above, the only additional potential impact to the soil resource is from subsidence, stemming from underground longwall mining operations. The effect of subsidence would manifest itself as cracks forming on the soil surface followed by a slumping, or settling, of the ground elevation as the geologic strata cave, at depth, behind the retreating longwall operation. Some cracks would remain on the surface at the conclusion of mining. These cracks typically occur on the surface over gate roads and the edges of longwall panels. These cracks would not likely be visible to any degree due to the existing vegetation and the propensity of these cracks to naturally fill. The acreage of soil which would be denuded by cracking cannot be calculated but would likely be minimal considering the acreage involved. It is unlikely that a measurable volume of soil would be lost to erosion given the linear nature

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and short slope lengths of these features. Similarly, no measurable decrease in soil productivity is expected.

3.4.3.5 Effects of Alternative C

Compared to Alternative B, the affects of subsidence under this alternative would be greater given the somewhat larger lease areas involved, along with the employment of multi-seam mining activities. With multi-seam mining, the depth to which geologic strata cave behind the retreating longwall machine would be greater which, in turn, could result in deeper surface cracks. In terms of the acreage involved, the lease areas under Alternative C are approximately 673 acres (approximately 10 percent) greater than under Alternative B. Therefore, a somewhat larger acreage could be subject to the effects of subsidence.

3.4.3.6 Effects of Alternative D

Alternative D is identical to Alternative C except that subsidence would not be permitted under specific areas such as Terror Creek, Hubbard Creek, or the Curecanti-Rifle 230/345 kV electric transmission line. Therefore, the effects to soils as a result of multi-seam mining would be the same, only over a slightly smaller lease area.

3.4.4 Cumulative Impacts

The acreage of soils proposed to be affected by surface disturbances on the coal lease tracts and exploration license areas totals approximately 33.5 acres. Approximately 70 acres of previous disturbances are associated with the existing Bowie No. 2 Mine with an additional 10 to15 acres of disturbance planned under other proposed permits. At the Sanborn Creek Mine, approximately 95 acres have been disturbed and an additional 15 acres of disturbance is planned for the Elk Creek portal area. Therefore, the acreage of soils proposed to be directly affected by any alternative under consideration represents an increase in disturbed area of approximately 10 percent. The proposed disturbances equal less than 1 percent of the total acreage involved with the exploration license area and coal lease tracts. The impacts related to subsidence would not measurably increase these acreage relationships.

3.4.5 Possible Mitigation and Monitoring

Proper soil management and reclamation measures are required by the surface management agencies on disturbed sites. Colorado DMG would also require proper soil management procedures as part of their exploration and mine permits.

3.5 SURFACE WATER HYDROLOGY

***Issue:** Identify and minimize impacts to water quality and hydrology to maintain the integrity of watersheds within and surrounding the lease tract areas. Maintain adequate flows to drainages and ditches above underground mining activity. Areas of concern include: the potential to alter existing hydrologic systems; the potential to impact irrigation canals and the Terror Creek Reservoir by subsidence; alteration of downstream flow rates; alteration of existing springs and seeps; changes in surface water chemistry as a result of mining operations; and, impacts to water rights on Terror Creek, Hubbard Creek, Bear Creek, and Elk Creek.*

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3.5.1 Introduction

The study area required to address the impacts to surface water hydrology from leasing the Iron Point and Elk Creek Coal Lease Tracts and the Iron Point Exploration License area is defined by the watershed boundaries of the local drainages (Figure 16, Regional Hydrology Map). The following sections include discussion of the regional hydrologic setting, flow characteristics within the surface drainage system, analysis of surface water quality, water rights, and environmental consequences of exploration and mining on surface water resources.

The following information sources were used for this evaluation:

- Surface water quality and quantity data for regional hydrology from the USGS;
- Surface water quality and quantity data for the Iron Point and Elk Creek Coal Lease Tracts and the Iron Point Exploration License area from Bowie and Oxbow;
- Surface water rights information for the drainages in the vicinity of the study area from the Colorado State Engineers Office, Division of Water Resources; and,
- Review of Bowie and Oxbow data, including annual hydrology reports, permit applications, and other reports related to surface water hydrology.

To respond to issues raised during scoping, effects of subsidence on Terror Creek Reservoir were included in the analysis. It should be noted that the Terror Creek Reservoir is not within the proposed Iron Point Coal Lease Tract and is outside the area of influence defined by the subsidence angle of draw. See *Figure 14, Subsidence Potential Map*, and *Appendix K, Subsidence Evaluation*.

3.5.2 Affected Environment

The Iron Point and Elk Creek Coal Lease Tracts and the Iron Point Exploration License area are located within the North Fork of the Gunnison River basin.

3.5.2.1 Regional Surface Water Hydrology

The North Fork of the Gunnison River drains the coal lease and exploration license areas. The North Fork of the Gunnison River joins the Black Canyon of the Gunnison River downstream of the Hotchkiss fish hatchery to become the Gunnison River.

There are two USGS monitoring locations along this reach: North Fork of the Gunnison River near Somerset, Colorado (Station No. 09132500), and North Fork of the Gunnison River below Leroux Creek, near Hotchkiss, Colorado (Station No. 09135950).

Stream flow has been monitored at the station near Somerset since October 1933. The drainage area at the Somerset station is 526 square miles. The highest annual mean flow at this station during the period of record for water years 1934 through 1997 was 829 cfs in 1984

The highest instantaneous peak flow of 9,220 cfs was recorded on May 24, 1984. The lowest annual mean flow for the same station and period of record was 114 cfs in 1977.

The station below Leroux Creek is a new station with data collected for a three month period during the summer of 1997. Flow during the period from July to September ranged from a minimum daily mean of 94 cfs to a maximum daily mean of 848 cfs. (USGS, 1997)

Surface water quality in the North Fork of the Gunnison River in the vicinity of Paonia is good with low concentrations of TDS, nitrate, nitrite, and metals. The water is of calcium bicarbonate type.

3.5.2.2 Project Area Surface Water Hydrology

The coal lease tracts and exploration license area are tributary to the North Fork of the Gunnison River between Somerset and Paonia, Colorado. *Figure 16, Regional Hydrology Map*, shows the watershed areas that encompass the coal lease tract and exploration areas. *Figure 17, Regional Stream Network*, illustrates the relative location of the tributary streams to the North Fork of the Gunnison River. Hubbard Creek and Terror Creek drain the Iron Point Exploration license area and the Iron Point Coal Lease Tract. Hubbard Creek, Bear Creek, and a small portion of Elk Creek drain the Elk Creek Coal Lease Tract.

Watershed (drainage basin) information used to characterize the streams draining the project area includes: drainage area, elevation range, stream length, and stream order. Drainage area is the area of the watershed from its headwaters to its confluence with the next lower stream. Elevation range is determined from the highest point in the watershed to the elevation at the confluence with the next lower stream. Channel length is the total length of the stream from its origin at the headwaters to its confluence with the next lower stream. Stream order is a classification of a watershed using the number of tributaries found within the watershed. A first order stream has no tributaries. A second order stream is a reach downstream of the confluence of at least two first order streams. Ordering continues in this fashion indicating the relative complexity of the watershed.

Iron Point Exploration License Area and Coal Lease Tract - Hubbard Creek is a fourth order perennial drainage that has an estimated drainage basin area of 58.1 square miles. Elevation ranges from 11,327 feet on Electric Mountain to 5,870 feet at the confluence with the North Fork of the Gunnison River. The main channel length is 17.60 miles long. Approximately 20 percent of the Hubbard Creek drainage basin lies within the coal lease tract and the exploration license areas. An area of 1.3 square miles is located within the Elk Creek Coal Lease Tract. A 3.3 square mile area is located within the Iron Point Coal Lease Tract and a 7.0 square mile area is located within the Iron Point Exploration License area.

Terror Creek is a third order perennial drainage with a drainage basin area of 29.4 square miles. Elevation ranges from 11,200 feet north of Rex Reservoir to 5,740 feet at the confluence with the North Fork of the Gunnison River. The main channel length is 12.35 miles long. Thirteen percent of the Terror Creek drainage basin lies within the coal lease tract and exploration license area. An area of 1.8 square miles is located within the Iron Point Coal Lease Tract. A 1.9 square mile area is located within the Iron Point Exploration License area.

Baseline water quality and flow data for the Bowie No. 1 and No. 2 mines have been collected for several years. Bowie has initiated additional baseline monitoring in the Iron Point Coal

Lease Tract and Iron Point Exploration License area, north of the existing mines. *Table 3.5-1, Surface Water Monitoring Summary*, describes the period of record for the surface water monitoring network.

There are twelve surface water monitoring locations on Hubbard Creek and its tributaries. Instantaneous flow data and water quality data are monitored at each location. Surface water monitoring locations are shown on *Figure 16, Regional Hydrology Map*. Surface water flow is discussed in this section, while water quality is addressed in Section 3.5.2.3, Project Area Surface Water Quality.

Iron Point Gulch (D34-12), Dove Gulch (D33-13, D34-13, D34-15), and Sheep Corral Gulch (D2-1, D33-14) have flow monitoring data available from October 1997 through April 1999 (data available at the time of this Draft EIS). Instantaneous flow is recorded at most of these stations in the spring and early summer, and they are dry in the fall and winter months. Lower Dove Gulch (D34-15) is perennial with flows ranging from 0.5 cfs in June 1998 to 0.03 cfs in September and November 1998.

Flow in Upper Hubbard Creek (Hub-up), located at the mine entrance of the Blue Ribbon Mine ranges from 3.5 cfs (September 1996) to 86.5 cfs (June 1997). The period of record for this station is September 1996 to December 1998.

Flow in Lower Hubbard Creek (Hub-low), located at the confluence of Hubbard Creek with the North Fork of the Gunnison River ranges from 2.9 cfs (September 1998) to 85.5 cfs (June 1997). The period of record for Lower Hubbard is also September 1996 to December 1998. The Upper Deertrail Ditch monitoring location (Deer-up) diverts water from Hubbard Creek between the upper and lower stations. Flow and quality are monitored at the headgate of Deertrail Ditch (Deer-up). Flow in the Deertrail Ditch ranges from 0.61 cfs (March 1997) to 4.81 cfs (December 1998). Period of record for this ditch is May 1996 to December 1998.

Upper Freeman Gulch (Free-up) was dry, or had no measurable flow for the period June 1996 to December 1998. Surface water was measured in Lower Freeman Gulch (Free-low) twice during the June 1995 through December 1998 period of record. Flow on June 17, 1997 was 1.88 cfs and on June 18, 1998 flow was 3.75 cfs.

Lower Deertrail Ditch (Deer-low) is monitored at the downstream end of the Deertrail Ditch where it discharges into the Fire Mountain Canal. The period of record for this station is from May 1996 to December 1998. Flow ranges from 0 cfs in June 1998 and September 1998 to 0.16 cfs on November 19, 1997.

Six monitoring stations measure ephemeral streams that are directly tributary to the North Fork of the Gunnison River. Upper and Lower Stephens Draw, A Gulch, B Gulch, C Gulch and D Gulch are located within the permit boundary of the Bowie No. 2 Mine. These stations were monitored from February 1995 through December 1998. These streams are dry for much of the year. Flow events were captured only in the Lower B and C gulches. These flow measurements are less than 0.01 cfs, and there is no seasonal pattern.

There are four monitoring stations along the Terror Creek drainage. Cottonwood Stomp (D32-5) is located approximately 1 mile downstream of the Terror Creek Reservoir. Monitoring began at this station in June 1998. Four instantaneous flow measurements were taken between June and November 1998. Flow was less than 1 cfs in June and July and dry in

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Table 3.5-1
Surface Water Monitoring Summary

Owner/Mine	Drainage	Site Designation	Monitoring Period(s)	Comments
Oxbow/Sanborn	North Fork of Gunnison	NF-1	3/91-12/94	
Oxbow/Sanborn	North Fork of Gunnison	NF-1	3/91-12/94	
Oxbow/Sanborn	North Fork of Gunnison	NF-3	3/91-12/94	
Oxbow/Sanborn	North Fork of Gunnison	E-1	3/80-4/82	Field parameters & flow data
Oxbow/Sanborn	North Fork of Gunnison	E-2	3/80-4/82	Field parameters & flow data
Oxbow/Sanborn	North Fork of Gunnison	B-1	3/80-4/82	Field parameters & flow data
Oxbow/Sanborn	North Fork of Gunnison	B-2	3/80-4/82	Field parameters & flow data
Bowie/Bowie No. 2	Drainage System	A-Gulch-l0	2/95-19/98	Field parameters & flow data
Bowie/Bowie No. 2	Drainage System	B-Gulch-lo	2/95-19/98	
Bowie/Bowie No. 2	Drainage System	B-Gulch-up	2/95-19/98	Field parameters & flow data
Bowie/Bowie No. 2	Drainage System	C-Gulch-lo	2/95-19/98	
Bowie/Bowie No. 2	Drainage System	C-Gulch-up	2/95-19/98	Field parameters & flow data
Bowie/Bowie No. 2	Drainage System	D-Gulch-lo	2/95-19/98	Field parameters & flow data
Bowie/Bowie No. 2	Drainage System	D-Gulch-up	2/95-19/98	Field parameters & flow data
Bowie/Bowie No. 2	Sheep Corral Drainage System	D2-1	10/97-4/99	
Bowie/Bowie No. 2	Terror Creek - Drainage System	D32-4	10/97-11/98	
Bowie/Bowie No. 2	Terror Creek - Drainage System	D32-5	6/98-11/98	
Bowie/Bowie No. 2	Upper Dove Gulch	D33-13	11/98	
Bowie/Bowie No. 2	Upper Sheep Corral Gulch	D33-14	11/98	
Bowie/Bowie No. 2	Iron Point - Drainage System	D34-12	10/97-4/99	
Bowie/Bowie No. 2	Dove Gulch - Drainage System	D34-13	10/97-4/99	
Bowie/Bowie No. 2	Hubbard Creek - Drainage System	D34-14	10/97-4/99	
Bowie/Bowie No. 2	Dove Gulch - Drainage System	D34-15	6/98-11/98	
Bowie/Bowie No. 2	Canal - Deertrail Ditch	Deer-lo	5/98-12/98	
Bowie/Bowie No. 2	Canal - Deertrail Ditch	Deer-up	5/98-12/98	
Bowie/Bowie No. 2	Freeman Gulch - Drainage System	Free-low	6/95-12/98	
Bowie/Bowie No. 2	Freeman Gulch - Drainage System	Free-up	6/95-12/98	
Bowie/Bowie No. 2	Hubbard Creek - Drainage System	Hub-low	6/96-12/98	
Bowie/Bowie No. 2	Hubbard Creek - Drainage System	Hub-up	9/96-12/98	
Bowie/Bowie No. 2	North Fork - Drainage System	NFG-low	9/96-12/98	

Table 3.5-1
Surface Water Monitoring Summary

Owner/Mine	Drainage	Site Designation	Monitoring Period(s)	Comments
Bowie/Bowie No. 2	North Fork - Drainage System	NFG-up	9/96-12/98	
Bowie/Bowie No. 2	Stephens Draw - Drainage System	Steph-low	9/96-12/98	
Bowie/Bowie No. 2	Stephens Draw - Drainage System	Steph-up	7/95-12/98	
Bowie/Bowie No. 2	Canal - Terror Creek	TC-low	9/96-12/98	
Bowie/Bowie No. 2	Terror Creek - Drainage System	TC-up	9/96-12/98	
Bowie/Bowie No. 2	Terror Creek - Drainage System	TC-west	4/97-12/98	

September and November. Upper Terror Creek (TC-up) is located on Terror Creek immediately upstream of the confluence with West Terror Creek. It has a period of record from September 1996 and December 1998. Flow ranges from 0 cfs in September 1996 to 44 cfs on April 27,1997. West Terror Creek (TC-west) is located on West Terror Creek immediately above the confluence with Terror Creek. The period of record for West Terror Creek is April 1997 through December 1998. Flow ranges from 0.8 cfs on August 24, 1997 to 198 cfs on April 27, 1997. Lower Terror Creek (TC-low) is located on Terror Ditch below the headgate. The period of record is from September 1996 through December 1998. Flow ranges from 0.1 cfs in April 1998 to 7.9 cfs on June 17, 1998.

Elk Creek Coal Lease Tract - Elk Creek is a third order intermittent drainage that is very narrow and steep-sided. The drainage basin area is 5.6 square miles. Elevation ranges from 9,780 feet near Buck Mesa to 6,000 feet at the confluence with the North Fork of the Gunnison River. The channel length is 5.64 miles. Eleven percent of the Elk Creek drainage basin lies within the Elk Creek Coal Lease Tract. The channel of Elk Creek is primarily located east of the coal lease tract.

Bear Creek is also a third order intermittent drainage and the drainage basin area is 8.7 square miles. Elevation ranges from 9,735 feet near Buck Mesa to 5,930 feet at the confluence with the North Fork of the Gunnison River. The channel length is 7.73 miles. Forty-seven percent of the Elk Creek drainage basin lies within the Elk Creek Lease Tract. A small portion (0.02 square miles) lies within the Iron Point Exploration License area.

Oxbow has collected limited surface water data within the current mine permit area for the Sanborn Creek Mine. *Figure 16, Regional Hydrology Map*, shows the locations of these monitoring points. Monitoring in Elk Creek and Bear Creek was collected by Oxbow in the early 1980s. *Table 3.5-1, Surface Water Monitoring Summary*, describes the period of record for the surface water monitoring network.

There are two surface water monitoring locations on Elk Creek. Station E-1, Lower Elk Creek, is located at the confluence of Elk Creek with the North Fork of the Gunnison River. Station E-2, Upper Elk Creek, is located southeast of the Elk Creek Coal Lease Tract boundary on Elk Creek. The period of record available for stations E-1 and E-2 is from April 1980 to April 1982. Frequency of monitoring for E-1 and E-2 was twice a month for the summer of 1980, then monthly (some exceptions in the winter months) through April 1982. Surface water flow for Station E-1 ranges from 0 cfs in March, 1980, and June through August 1981 to 28.9 cfs on May 21, 1980. Surface water flow for Station E-2 ranges from 0.01 cfs in August 1981 to 28.9 cfs on May 21, 1980.

There are two surface water monitoring locations on Bear Creek. Station B-1, Lower Bear Creek, is located at the confluence of Bear Creek with the North Fork of the Gunnison River. Station B-2, Upper Bear Creek is located at a boundary of the Elk Creek Coal Lease Tract as it crosses Bear Creek. The period of record available for stations B-1 and B-2 is from March 1980 to April 1982. Like the Elk Creek stations the frequency of monitoring for B-1 and B-2 was also twice a month for the summer of 1980, then monthly until the spring of 1982. Flow measurements for Station B-1 range from 0.11 cfs in August 1980 to 61.13 cfs on May 21, 1980. Flow measurements at Station B-2 range from 0 cfs in August and September 1980, to 51.35 cfs on May 21, 1980.

3.5.2.3 Project Area Surface Water Quality

Baseline water quality data has been collected on streams within the Iron Point Coal Lease Tract since the mid-1990's. Baseline data collection further upstream into the exploration license area began in 1997. The frequency of monitoring is quarterly, and there is no monitoring in the winter months due to limited access. *Figure 16, Regional Hydrology Map*, shows the location of surface water monitoring stations; and *Table 3.5-2, Selected Surface Water Quality Summary*, describes summary statistics for water chemistry collected.

Oxbow has collected water quality data from areas within their current operations. However, Elk Creek and Bear Creek, which are located adjacent to and within the Elk Creek Coal Lease Tract, have limited water quality data available.

Perennial streams in the area, including the North Fork of the Gunnison River, Hubbard Creek, and Terror Creek have been assigned stream classifications by the Water Quality Control Commission, that define standards for water quality. These streams are classified as Class 1 Aquatic Life Cold, Class 1 Recreation (waters where human ingestion of small quantities is likely to occur), Water Supply and Agriculture (CDPHE, 1999).

The following discussion addresses average water quality data and parameters regulated by the Colorado Department of Public Health and environment standards. Several of the parameters listed in the Colorado Department of Public Health and Environment standards for the North Fork of the Gunnison River are consistently reported at, or below detection limits at most stations collected by Bowie. These parameters are arsenic, cadmium, copper, mercury, molybdenum, and selenium. Concentrations of zinc and lead are reported at, or near detection limits; however, these detection limits are higher than the chronic and acute standards for zinc and lead. Only total iron and total manganese were analyzed at the Oxbow stations on Elk Creek and Bear Creek.

Iron Point Coal Lease Tract and Exploration License Area - The surface water quality in streams that drain the Iron Point Coal Lease Tract and Exploration License area is relatively consistent, with only a few exceptions. Generally, streams in Hubbard and Terror creeks, and the North Fork of the Gunnison River are calcium bicarbonate type water. Four stations; Iron Point Gulch (D34-12), Dove Gulch (D34-15), Lower Freeman Gulch (Free-low), and Lower Stephens Gulch (Steph-low) are calcium/sodium bicarbonate type with high concentrations of

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Table 3.5-2
Selected Surface Water Quality Summary

	Temperature	*Field pH*	*Bicarbonate*	*Nitrate*	*Nitrite*	*TDS*	*TSS*	*Sulfate*	*Aluminum*	*IronT*	*Lead*	*ManganeseT*	*Selenium*	*Zinc*
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Varies
Hubbard C. above Iron Pt. (D04-14)														
Number of Samples	6	6	5	1	1	5	5	5	5	5	5	5	5	5
Minimum	3.2	7.1	74	0.06	-0.01	100	-5	-10	0.05	0.15	-0.04	0.006	-0.001	-0.010
Maximum	19.3	8.3	124	0.06	-0.01	160	6	20	1.18	0.96	-0.04	0.017	-0.001	0.020
Average	10.0	7.8	97	0.06	-0.01	136	5	9	0.32	0.37	-0.04	0.013	-0.001	0.008
Standard Deviation	6.6	0.5	21	0.00	0.00	23	3	7	0.48	0.34	0.00	0.004	0.000	0.007
Hubbard C. below Blue Rib. (Hub-up)														
Number of Samples	9	9	6	5	5	6	6	6	6	6	6	6	6	6
Minimum	0.5	8.1	57	-0.02	-0.01	100	-5	-10	0.07	0.11	-0.02	0.005	-0.001	-0.010
Maximum	17.1	9.0	137	0.06	-0.01	180	38	10	2.25	1.65	-0.04	0.035	-0.040	0.040
Average	7.9	8.5	106	0.03	-0.01	140	12	6	0.59	0.84	-0.02	0.017	-0.004	0.018
Standard Deviation	5.9	0.3	32	0.02	0.00	32	13	3	0.89	0.62	0.01	0.011	0.008	0.014
Hubbard C. at Confluence (Hub-low)														
Number of Samples	10	10	6	5	5	6	6	6	6	6	6	6	6	6
Minimum	2.3	8.1	62	-0.02	-0.01	100	-5	-10	0.05	0.09	-0.02	0.009	-0.001	-0.010
Maximum	20.0	9.3	155	0.29	0.01	260	34	50	1.91	1.44	-0.08	0.034	-0.320	0.040
Average	10.1	8.6	115	0.07	0.006	165	13	20	0.64	0.59	-0.02	0.017	-0.005	0.016
Standard Deviation	6.7	0.4	35	0.12	0.002	55	12	18	0.81	0.53	0.01	0.009	0.008	0.014
Upper Deertrail Ditch (Deer-up)														
Number of Samples	12	12	6	7	7	6	6	6	6	6	6	6	6	6
Minimum	2.0	8.0	51	-0.02	-0.01	50	-5	-10	0.06	0.13	-0.02	0.006	-0.001	-0.010
Maximum	19.6	9.1	139	0.06	0.02	200	52	20	2.03	1.85	0.05	0.033	-0.040	0.030
Average	10.2	8.6	95	0.03	0.006	126	18	10	0.90	0.86	0.02	0.022	-0.003	0.016
Standard Deviation	6.6	0.4	36	0.03	0.006	46	19	6	0.83	0.85	0.01	0.009	0.007	0.009
Lower NF Gunnison (NFG-low)														
Number of Samples	10	10	6	5	5	6	6	6	6	6	6	6	6	6
Minimum	1.8	8.1	61	-0.02	-0.01	80	-5	-10	0.10	0.11	-0.02	0.014	-0.001	-0.010
Maximum	17.8	8.7	123	0.16	0.01	150	52	20	1.29	1.48	0.05	0.031	-0.040	0.030
Average	10.2	8.4	92	0.05	0.006	120	14	14	0.51	0.49	0.02	0.020	-0.004	0.017

Table 3.5-2
Selected Surface Water Quality Summary

	Temperature	*Field pH*	*Bicarbonate*	*Nitrate*	*Nitrite*	*TDS*	*TSS*	*Sulfate*	*Aluminum*	*IronT*	*Lead*	*ManganeseT*	*Selenium*	*Zinc*[7]
Water Quality Std. (mg/l)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		250	[illegible]	1.00	Varies	0.050	0.020	Varies
Standard Deviation	5.9	0.2	26	0.06	0.002	32	19	7	0.53	0.52	0.01	0.006	0.008	0.010
Terror C. below Confl W. Terror (TC-up)														
Number of Samples	10	10	6	5	5	6	6	6	6	6	6	6	6	6
Minimum	0.6	8.1	66	-0.02	-0.01	100	-5	-10	0.20	0.26	-0.02	0.018	-0.001	-0.010
Maximum	19.2	8.6	103	0.04	0.01	150	52	20	3.70	2.61	-0.04	0.140	-0.040	0.040
Average	8.6	8.4	86	0.02	0.006	122	16	8	1.10	0.92	-0.02	0.047	-0.004	0.017
Standard Deviation	6.7	0.1	16	0.01	0.002	17	20	6	1.33	0.89	0.01	0.046	0.008	0.013
North Fork of Gunnison (NF-1)														
Number of Samples	?	?	?			?	?	?	?	?	?	?	?	?
Minimum	0.0	7.2	35			4	1	5	0.01	0.03	0.00	0.000	0.001	0.000
Maximum	24.0	9.5	140			208	250	21	5.63	6.26	0.06	0.183	0.038	0.090
Average	9.6	8.5	84			102	36	11	1.12	0.84	0.02	0.040	0.004	0.012
Standard Deviation	?	?	?			?	?	?	?	?	?	?	?	?
North Fork of Gunnison (NF-2)														
Number of Samples	?	?	?			?	?	?	?	?	?	?	?	?
Minimum	0.0	6.9	22			30	1	4	0.01	0.03	0.00	0.005	0.001	0.003
Maximum	24.0	9.5	200			396	170	21	4.12	5.71	1.00	0.140	0.014	0.092
Average	9.5	8.5	93			132	29	11	0.69	0.68	[illegible]	0.030	0.004	0.012
Standard Deviation	?	?	?			?	?	?	?	?	?	?	?	?
North Fork of Gunnison (NF-3)														
Number of Samples	?	?	?			?	?	?	?	?	?	?	?	?
Minimum	2.0	7.2	490			46	6	4	0.010	0.050	0.0025	0.013	0.0005	0.0025
Maximum	23.0	8.6	150			172	50	25	0.46	0.45	0.03	0.109	0.007	0.025
Average	12.3	8.0	100			116	16.8	11.6	0.187	0.259	0.021	0.034	0.004	0.006
Standard Deviation	?	?	?			?	?	?	?	?	?	?	?	?

Reference for Standards
EPA. Primary Drinking Water Standards, Colorado Department of Health, North Fork Gunnison River

TDS. Metals concentrations at these four stations were below detection limits, or within the state standards for total iron, manganese and selenium with one exception. The Dove Gulch station had a concentration of total iron that slightly exceeded the standard in July 1998.

Water quality data at Lower B and C gulches are calcium/sodium sulfate water types. Water quality at these stations is poor with high concentrations of total dissolved solids (TDS), nitrate, nitrite and sulfate. They also have concentrations of total iron, manganese, selenium and zinc that exceed the state standards. These concentrations are believed to reflect impacts from past mining activity, in particular, the historic waste coal fines and mine portals that are located in the B and C gulches below the Bowie No. 2 Mine.

Water quality data collected from stations on the North Fork of the Gunnison River indicate calcium bicarbonate water type. Stations monitoring water quality on the North Fork of the Gunnison River collect data from points upstream and downstream from mining activity at both the Bowie and Oxbow Mines.

The monitoring stations on the North Fork of the Gunnison River monitored by Bowie are designated NFG-up, Upper North Fork of the Gunnison River, and NFG-low, Lower North Fork of the Gunnison River. NFG-up is located immediately upstream of the confluence of Hubbard Creek with the North Fork of the Gunnison River and NFG-low is located approximately 1,500 feet downstream of the confluence of Terror Creek with the North Fork of the Gunnison River.

The monitoring stations on the North Fork of the Gunnison monitored by Oxbow are designated NF-1, located upstream of the Sanborn Creek Mine facilities area, and NF-2, located at the Sanborn Creek Mine facilities area. There is a station on the North Fork of the Gunnison River located downstream; however, the period of record is much shorter than NF-1 and NF-2. Water quality is good with low concentrations of TDS, nitrate, nitrite and metals. There have been occasional exceedances of total iron and manganese; however, the average concentrations are below the state standard for both of these parameters.

Elk Creek Coal Lease Tract - Baseline water quality for Elk and Bear creeks is limited to TDS, TSS, alkalinity, total and dissolved iron, and total manganese for a period of record from May 1980 to April 1982. Concentrations of TDS and total suspended solids (TSS) are very high (averaging 2,300 mg/l and 75 mg/l, respectively) in Lower Bear Creek (B-1) at the confluence with the North Fork of the Gunnison River. During the early 1980s, several landslides may have impacted the water quality of Lower Bear Creek by increasing the sediment load of overland flow to Bear Creek (R. Dunrud, 1999, personal communication). Upper Bear Creek (B-2) had concentrations of TDS and TSS averaging 247 mg/l and 31.35 mg/l, respectively.

A portion of Elk Creek was diverted through a section of culvert in the early 1980s. The effects of this construction are seen in the concentrations of TDS and TSS during this time. Concentrations of TDS is high in both stations on Elk Creek (averaging 439 mg/l at E-2 and 434 mg/l at E-1). Average concentrations of total iron and total manganese also exceed the state standards during this period of record.

3.5.2.4 Seasonal Trends in Surface Water Quality

General seasonal trends in surface water quality were not obvious in reviewing the Bowie or Oxbow water quality data. The relatively short period of record likely explains the lack of significant trends. The water quality data for Oxbow reflects an earlier period of record that is also relatively short.

3.5.2.5 Water Users/Water Rights

The study area is located within the Colorado Division of Water Resources Division 4, District 40. Water rights for this district were obtained from this agency, and these are shown on *Figure 18, Water Rights*. *Table 3.5.3, Water Rights Summary for Wells, Springs, and Surface Water*, gives additional information about water rights located on *Figure 18, Water Rights*. The map and table include all water rights in an area bounded by a 1 mile buffer around the Iron Point Exploration License area, and the Iron Point and Elk Creek Coal Lease Tracts. Water rights originating from the North Fork of the Gunnison River between the Sanborn Creek surface facilities area and the Bowie No. 2 Mine surface facilities are also included, even though they may be located more than 1 mile from the lease area boundaries. Water rights originating from Hubbard Creek or west of Hubbard Creek are considered in the Iron Point Coal Lease Tract and the Iron Point exploration license area and those east of Hubbard Creek are considered in the Elk Creek Coal Lease Tract area.

Iron Point Coal Lease Tract and Exploration License Area - There are nine ditches originating from Hubbard Creek and its tributaries that are located within the boundaries described above. Four of these ditch headgates, the Wade Allen Ditch, the Carl Galphin Ditch, the Pilot Knob Ditch, and the Carter Ditch, are located north of the exploration license area, but within 1 mile of the boundary. The Wade Allen Ditch headgate is located on Hubbard Creek. The Carl Galpin Ditch headgate is located on Pilot Creek, tributary to Hubbard Creek. The Pilot Knob Ditch headgate is located just south of the Galpin Ditch headgate. The Carter Ditch headgate is located on Cottonwood Creek.

The Hubbard Creek Ditch headgate is located at the northern boundary of the exploration license area boundary on Hubbard Creek. The Blue Ribbon Ditch headgate is located on private land and is adjacent to the historic Blue Ribbon Mine on Hubbard Creek.

The Deertrail Ditch headgate is located on Hubbard Creek south and between the Elk Creek and Iron Point Coal Lease Tracts. The Majnik and Mayes Ditches are located south of the Deertrail Ditch.

There are two reservoirs within the Hubbard Creek drainage basin. The Terror Creek Reservoir (known as the Bruce Park Reservoir in the water rights listing), is located in the northwestern corner of the exploration license area. The reservoir straddles the Hubbard and Terror creek drainage basins with a dam in each basin. The water source is Hubbard Creek; however, water from the reservoir can be released to either Hubbard or Terror creeks. The Blue Ribbon Reservoir No. 1 feeds the Blue Ribbon Ditch mentioned above. See *Figure 18, Water Rights*.

There are seven ditches, or canals originating in the Terror Creek drainage basin. One canal, the Grand Mesa Canal No. 3, has a headgate located on the East Fork Terror Creek. It is located in the northwestern corner of the exploration license area, northwest of the Terror Creek Reservoir. The Garvin Mesa Pipeline and the Hughes Pipieline are located immediately west of the exploration license area on an unnamed tributary to East Fork Terror Creek.

The remaining four ditches have headgate locations south of the Iron Point Coal Lease Tract on Terror Creek. The Terror Ditch headgate is located approximately 0.6 miles south of the

Table 3.5-3
Water Rights Summary for Wells, Springs, and Surface Water

WATER RIGHT NAME	*Map #*	*TS*	*RNG*	*SEC*	*Q160*	*Q40*	*Q10*	*ADJ DATE*	*APRO DATE*	*USE TYPE **	*RATE ABS*	*VOL ABS*	*RATE COND*	*VOL COND*
BLUE RIBBON DITCH NO 1	2	13 S	91 W	2	NW	NW	NE	12/31/77	1/24/77	DOMIND	2			
BLUE RIBBON RES NO 1	2	13 S	91 W	2	NW	NW	SE	12/31/77	1/24/77	DOMIND	0	10.2		
BLUE RIBBON WELL	2	13 S	91 W	2	NW	NW	NE	12/31/77	1/24/77	DOMIND	0.033			
J & M SPRING & PL NO 2	3	13 S	91 W	3	NW	SW	SW	12/31/70	7/1/34	DOMSTK	0.004			
J & M SPRING & PL NO 1	4	13 S	91 W	4	NE	NE	SW	12/31/70	7/1/34	DOMSTK	0.009			
DEERTRAIL DITCH	11	13 S	91 W	11	NE	SW	NW	4/12/01	1890-11-01	IRR	1.25			
DEERTRAIL DITCH	11	13 S	91 W	11	NE	SW	NW	4/12/01	1893-06-01	IRR	0.322			
DEERTRAIL DITCH	11	13 S	91 W	11	NE	SW	NW	4/12/01	1893-06-06	IRR	0.344			
DEERTRAIL DITCH	11	13 S	91 W	11	NE	SW	NW	6/23/14	1893-07-01	IRR	1.594			
DEERTRAIL DITCH	11	13 S	91 W	11	NE	SW	NW	3/20/54	1890-11-05	DOMIRR	1.044			
DEERTRAIL DITCH	11	13 S	91 W	11	NE	SW	NW	3/20/54	2/15/07	INDIRR	0.294			
MAJNIK DITCH	14	13 S	91 W	14	NE	NW	NE	5/28/37	4/1/01	IRR	1.5			
MAYES DITCH	14	13 S	91 W	14	NE	NE	NE	6/23/14	6/1/02	IRR	0.375			
TERROR CREEK														
GRAND MESA CANAL HGT 3	29	12 S	91 W	29	SE	NE	SW	1/31/64	6/15/61	IRR			25	
GARVIN MESA PIPELINE CO	32	12 S	91 W	32	SW	NE	NW	12/31/76	9/25/76	DOM	0.04			
HUGHES PIPELINE	32	12 S	91 W	32	SW	SW	SE	12/31/77	1/7/77	DOM				
J & M SPRING & PL NO 3	4	13 S	91 W	4	NW	SW	SE	12/31/70	7/1/34	DOMSTK	0.009			
J & M SPRING & PL NO 4	4	13 S	91 W	4	NE	SW	NW	12/31/70	7/1/34	DOMSTK	0.011			
J & M SPRING & PL NO 5	4	13 S	91 W	4	NW	SE	NW	12/31/70	7/1/34	DOMSTK	0.011			
BARROW SPRING PIPELINE	5	13 S	91 W	5	NW	SW	SW	12/31/74	6/1/24	DOMRECSTK	0.1			
LEONARD SPRING NO 1	7	13 S	91 W	7	NE	SE	NE	12/31/74	6/1/20	DOMRECSTK	0.05			
LEONARD SPRING NO 2	7	13 S	91 W	7	NE	SE	NE	12/31/74	6/1/20	DOMRECSTK	0.05			
TERROR DITCH	17	13 S	91 W	17	NE	NE	SE	1889-06-17	1883-11-13	IRR	0			
TERROR DITCH	17	13 S	91 W	17	NE	NE	SE	4/12/01	1884-12-11	IRR	6			
TERROR DITCH	17	13 S	91 W	17	NE	NE	SE	2/10/30	5/1/01	IRR	6			
TERROR DITCH	17	13 S	91 W	17	NE	NE	SE	3/20/54	1884-12-11	DOM	1.5			
FAWCETT DITCH	21	13 S	91 W	21	SW	NE	SW	1889-06-17	1883-11-13	IRR	0.115			
FAWCETT DITCH	21	13 S	91 W	21	SW	NE	NW	3/20/54	4/15/44	IRRDOM	1.25			
HOLYBEE DITCH	21	13 S	91 W	21	NW	SW	SE	1889-06-17	1883-11-13	IRR	0.4			
FIRE MT CANAL	21	13 S	91 W	21	SW	NW	NE	2/10/30	7/1/03	IRR	70			
PUPIK POND	21	13 S	91 W	21	SW	NW	NE	12/31/80	6/23/80	DOMIRRSTK	0	2		
CLOUDS WELL	21	13 S	91 W	21	SE	SW	NW	12/31/75	10/4/73	DOM	0.003			

Type Key: IRR – Irrigation, DOM – Domestic, STK – Stock Watering, REC – Recreation, IND – Industrial, OTH – Other, COM – Commercial, WLD – Wildlife

Table 3.5-3
Water Rights Summary for Wells, Springs, and Surface Water

WATER RIGHT NAME	*Map #*	*TS*	*RNG*	*SEC*	*Q160*	*Q40*	*Q10*	*ADJ DATE*	*APRO DATE*	*USE TYPE **	*RATE ABS*	*VOL ABS*	*RATE COND*	*VOL COND*
N. FORK GUNNISON RIVER														
FIRE MT CANAL		0	0					3/20/54	6/1/35	IRR				
FIRE MT CANAL	23	13 S	90 W	8	SW	SW	SW	2/10/30	6/24/14	IRR	7.5			
FIRE MT CANAL	23	13 S	90 W	8	SW	SW	SW	3/20/54	1896-09-14	DOM	30			
FIRE MT CANAL	23	13 S	90 W	8	SW	SW	SW	3/20/54	6/1/35	IRROTH	106			
SOMERSET MINE WELL	24	13 S	90 W	8	SE	SW		12/31/79	6/8/78	IND	0.44			
BEAR WELL NO 1	25	13 S	90 W	8	SE	SE		12/31/93	7/15/82	COMDOM	0.222			
FIRE MT CANAL	23	13 S	90 W	17	NW	NW	SW	2/20/04	1896-09-14	IRR	50			
FIRE MT CANAL	23	13 S	90 W	17	NW	NW	SW	6/23/14	6/1/09	IRR	44.5			
FIRE MT CANAL	23	13 S	90 W	17	NW	NW	SW	2/10/30	7/1/09	IRR	0			
CARROL DITCH	26	13 S	90 W	18				2/20/04	1888-02-28	IRR	0.625			
NEW MAJNIK HOUSE WELL	27	13 S	91 W	14	NE	SE	SE	12/31/75	6/5/72	DOMSTK	0.033			
SELL NO 1 WELL	28	13 S	91 W	14	NE	SE	SE	12/31/72	5/1/20	DOMSTK	0.033			
JENKINS DITCH NO 1	29	13 S	91 W	15	SW	SW	SE	8/11/89	6/1/24	IRR	0.25			
JENKINS DITCH NO 1	29	13 S	91 W	15	SW	SW	SE	8/11/89	6/1/84	IRR	0.5			
JENKINS DITCH NO 2	30	13 S	91 W	15	SW	SE	NW	8/11/89	6/1/24	IRR	0.25			
JENKINS DITCH NO 2	30	13 S	91 W	15	SW	SE	NW	8/11/89	6/1/84	IRR	0.5			
STEWART DITCH	31	13 S	91 W	15	SW	SE	SE	12/31/94	12/31/20	STK	5			
BRONISH NO1 WELL	32	13 S	91 W	15	SE	NW	SE	12/31/72	5/1/40	DOMIRR	0.067			
STEPHENS DITCH	33	13 S	91 W	16	SE	SE	SE	3/20/54	5/10/08	DOM	0.25			
STEWART DITCH	33	13 S	91 W	21	NW			4/12/01	1882-06-01	IRR	1.25			
STEWART DITCH	33	13 S	91 W	21	NW			4/12/01	1892-12-27	IRR	4.73			
STEWART DITCH	33	13 S	91 W	21	NW			2/20/04	1895-11-30	IRR	50.75			
STEWART DITCH	33	13 S	91 W	21	NW			2/20/04	4/1/01	IRR	1.06			
STEWART DITCH	33	13 S	91 W	21	NW			2/10/30	12/13/10	IRR	19.25			
TOLTEC SPRING	34	13 S	91 W	21	SE	NW	NW	12/31/92	7/7/82	IRROTHSTKWLDDOM	0.06		0.03	
TRAIN LOADOUT WELL NO 1	35	13 S	91 W	29	SE	NW	NE	12/31/80	12/31/79	DOMIND	0.11		0.002	
BEAR CREEK														
BURTARD DITCH	36	12 S	90 W	30	NW	SW	NW	3/20/54	6/1/29	IRR	2.5			
HUBBARD CREEK														
WADE ALLEN DITCH	37	12 S	91 W	10	SE	NW	NE	5/28/37	6/1/04	IRR	3.5			
WADE ALLEN DITCH	37	12 S	91 W	10	SE	NW	NE	3/20/54	6/5/48	IRR	3.5			
CARL GALPIN DITCH	38	12 S	91 W	12	SW	SE	NW	1/31/64	1/1/56	IRR	3			
PILOT KNOB DITCH	39	12 S	91 W	12	SW	SW	SE	2/10/30	6/13/11	IRR	1			
HUBBARD CREEK	40	12 S	91 W	14	SE	NW	NW	12/31/84	5/4/84	MIN	3			
CARTER DITCH	24	12 S	91 W	24	NE	NW	SE	5/28/37	10/1/22	IRR	2.12			
BRUCE PARK RESERVOIR	28	12 S	91 W	28	SW	SE	SE	5/28/37	9/13/13	IRR	0	550.5		
BRUCE PARK RESERVOIR	28	12 S	91 W	28	SW	SE	SE	3/20/54	5/9/50	IRR	0	81.5		

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southern-most boundary of the Iron Point Coal Lease Tract. The Fire Mountain Canal (additional headgate), Fawcett Ditch, and the Holybee Ditch have headgates located near the confluence of Terror Creek with the North Fork of the Gunnison River. These ditches are all located more than 1 mile south of the Iron Point Coal Lease Tract area, but they were included because the water source could be impacted upstream by the proposed mining.

Seven ditches originating in the North Fork of the Gunnison River were also included because of the potential that the water source could be impacted upstream by mining. They are the Fire Mountain Canal, the Carrol Ditch, the Jenkins Ditches No. 1 and 2, the Stewart Ditch, the Stephens Ditch, and an additional headgate for the Stewart Ditch.

Elk Creek Coal Lease Tract - There is one surface water right listed in the Bear Creek drainage basin. The Burtard Ditch headgate is located on Bear Creek, approximately 0.6 miles north of the Elk Creek Coal Lease Tract. There are no surface water rights in the Elk Creek drainage.

3.5.2.6 Influence of Past Mining on Surface Water

Various National Pollution Discharge and Elimination System (NPDES) permits granted to the current mine operators regulate impacts of current and historical mining on local streams. Monitoring on the North Fork of the Gunnison River shows little impact to the water quality from current or historical mining. Occasional increased concentrations of metals have been observed during periods of increased runoff during the spring. The high sulfate concentrations found in the B and C gulches also do not appear to impact the water quality of the North Fork of the Gunnison River.

Subsidence impacts from past mining have been observed in several areas. *Appendix K, Subsidence Evaluation*, describes a subsidence area near Bear Creek undermined by room and pillar mining techniques. Overburden in this area is less than 500 feet thick. Although subsidence was observed in the form of cracks in the weathered bedrock and colluvium from 15 to 100 feet above the stream channel, there were no cracks observed in saturated alluvium underlying the stream. There was also no evidence of loss of flow observed downstream in Bear Creek. The soils and alluvium in the near-surface zone typically behave as a yieldable type of material, that is, they have the ability to yield or stretch without rupturing or breaking.

3.5.3 Environmental Consequences

3.5.3.1 Summary

Potential environmental consequences of leasing (and eventual mining of) the Iron Point and Elk Creek Coal Lease Tract and granting the Iron Point Exploration License include the following impacts:

- Dewatering of the D coal seam could disrupt flow on some sections of Hubbard Creek, which are fed from the D seam;
- Water discharge from the mines to surface streams could impact the quality of water in the receiving streams;

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- Subsidence caused by longwall mining can potentially disrupt stream flow and ponds directly above the underground mine and within the angle of draw. Other mine subsidence impacts could include changes in drainage channel morphology resulting in changes in general surface gradients, which could lead to head cutting, pooling, soil erosion, and sedimentation; and,

- Increased construction and use of surface facilities could increase sedimentation.

Figure 14, Subsidence Potential Map, describes the subsidence impacts within potential zones ranging from "very low to low" potential for subsidence, to "high to very high" potential. *Table 3.5-4, Water Rights Impact Summary*, specifically addresses the impact to stream monitoring locations, as well as specific water rights.

3.5.3.2 Effects of Alternative A (No-Action)

The No-Action Alternative would preclude impacts from the Iron Point and Elk Creek Coal Lease Tracts and the Iron Point Exploration License area, as exploration activities and mine development would not occur. There would be no surface water impacts from the lease tracts and exploration license area.

Existing impacts to surface water quality from current and past mining, as well as other current land uses would continue. Bowie would continue mining the D seam from their fee (private) reserves. Treatment of water discharged from the existing mines would continue to be regulated by the Colorado Department of Public Health and Environment through NPDES permits. Water use from the existing operation of the Bowie No. 2 mine varies seasonally and would be met with a variety of water rights, including 0.5 cfs from the Deertrail Ditch.

Oxbow would finish longwall mining in the Sanborn Creek Mine and develop and mine fee (private) reserves from the planned Elk Creek Mine. Dewatering operations in these mines would continue, and mine discharge would continue to be treated and released to the North Fork of the Gunnison River under provisions of an existing NPDES permit.

3.5.3.3 Effects Common to All Action Alternatives.

Direct Effects - For all alternatives, coal would be mined by longwall techniques. The direct effects of this mining on surface water resources is discussed in this subsection.

Iron Point Exploration License Area and Coal Lease Tract - In considering Alternatives B, C, and D, the Iron Point Exploration License would be approved, and the Iron Point Coal Lease Tract would be offered for leasing. Access road and drilling pad construction that would be required by the exploration drilling program could cause minor impacts to surface water resources due to sedimentation. There would be no negative impact to the quantity of flow in area streams from the exploration activities. Provided that the exploration firm(s) would obtain water under existing rights, which is required by the Colorado Division of Water Resources, there would be no impacts to water users or water rights. Water usage for exploration would be relatively minor (5 to 6 acre-feet/year), and such usage would be only during drilling activities that would be conducted for two years under an exploration license. In addition, such drilling would be seasonal, conducted during the dry (late spring, summer, autumn) months of the year.

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Table 3.5-4
Water Rights Impact Summary

Water Right Name	Map #	Location						Overburden Thickness			
		TS	RNG	SEC	Q160	Q40	Q10		Alt. B	Alt. C	Alt. D
Bear Creek											
Burtard Ditch	36	12S	90W	30	NW	SW	NW	2400	–	–	–
Hubbard Creek											
Wade Allen Ditch	37	12S	91W	10	SE	NW	NE	2500+	–	–	–
Wade Allen Ditch	37	12S	91W	10	SE	NW	NE	2500+	–	–	–
Carl Galpin Ditch	38	12S	91W	12	SW	SE	NW	2500+	–	–	–
Pilot Knob Ditch	39	12S	91W	12	SW	SW	SE	2500+	–	–	–
Hubbard Creek	40	12S	91W	14	SE	NW	NW	2500+	–	–	–
Carter Ditch	1	12S	91W	24	NE	NW	SE	2475	–	–	–
Bruce Park Reservoir	2	12S	91W	28	SW	SE	SE	2125	Low	Low	Low
Bruce Park Reservoir	2	12S	91W	28	SW	SE	SE	2125	Low	Low	Low
Blue Ribbon Ditch No. 1	3	13S	91W	2	NW	W	NE	50	Very High	Very High	High
Blue Ribbon Reservoir No. 1	4	13S	91W	2	NW	NW	SE	(1)-	Very High	Very High	High
Blue Ribbon Well	5	13S	91W	2	NW	NW	NE	50	Very High	Very High	High
J&M Spring & PL No. 2	6	13S	91W	3	NW	SW	SW	1175	Moderate	Moderate	Moderate
J&M Spring & PL No. 1	7	13S	91W	4	NE	NE	SW	1325	Moderate	Moderate	Moderate
Deertrail Ditch	8	13S	91W	11	NE	SW	NW	–	Very High	Very High	High

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Table 3.5-4
Water Rights Impact Summary

Water Right Name	Map #	Location						Overburden Thickness			
		TS	RNG	SEC	Q160	Q40	Q10		Alt. B	Alt. C	Alt. D
Hubbard Creek (continued)											
Deertrail Ditch	8	13S	91W	11	NE	SW	NW	--	Very High	Very High	High
Deertrail Ditch	8	13S	91W	11	NE	SW	NW	--	Very High	Very High	High
Deertrail Ditch	8	13S	91W	11	NE	SW	NW	--	Very High	Very High	High
Deertrail Ditch	8	13S	91W	11	NE	SW	NW	--	Very High	Very High	High
Deertrail Ditch	8	13S	91W	11	NE	SW	NW	--	Very High	Very High	High
Majnik Ditch	9	13S	91W	14	NE	NW	NE	--	Very High	Very High	High
Mayes Ditch	10	13S	91W	14	NE	NE	NE	--	Very High	Very High	High
Terror Creek											
Grand Mesa Canal HGT 3	11	12S	91W	29	SE	NE	SW	2125	Low	Low	Low
Garvin Mesa Pipeline Co.	12	12S	91W	32	SW	NE	NW	1425	Low	Low	Low
Hughes Pipeline	13	12S	91W	32	SW	SW	SE	1000	Low	Low	Low
J&M Spring & PL No. 3	14	13S	91W	4	NW	SW	SE	850	High	High	High
J&M Spring & PL No. 4	15	13S	91W	4	NE	SW	NW	1375	Low	Low	Low
J&M Spring & PL No. 5	16	13S	91W	4	NW	SE	NW	1025	Moderate	Moderate	Moderate
Barrow Spring Pipeline	17	13S	91W	5	NW	SW	SW	700	Low	High	Low
Leonard Spring No. 1	18	13S	91W	7	NE	SE	NE	1075	--	--	--

Table 3.5-4
Water Rights Impact Summary

Water Right Name	Map #	Location						Overburden Thickness			
		TS	RNG	SEC	Q160	Q40	Q10		Alt. B	Alt. C	Alt. D
Terror Creek (continued)											
Leonard Spring No. 2	19	13S	91W	7	NE	SE	NE	1075	--	--	--
Terror Ditch	20	13S	91W	17	NE	NE	SE	--	Very High	Very High	Low
Terror Ditch	20	13S	91W	17	NE	NE	SE	--	Very High	Very High	Low
Terror Ditch	20	13S	91W	17	NE	NE	SE	--	Very High	Very High	Low
Terror Ditch	20	13S	91W	17	NE	NE	SE	--	Very High	Very High	Low
Fawcett Ditch	21	13S	91W	21	SW	NE	SW	--	--	--	--
Fawcett Ditch	21	13S	91W	21	SW	NE	NW	--	--	--	--
Holybee Ditch	22	13S	91W	21	NW	SW	SE	--	--	--	--
Fire Mountain Canal	23	13S	91W	21	SW	N	NE	--	--	--	--
Pupik Pond	24	13S	91W	21	SW	NW	NE	--	--	--	--
Clouds Well	25	13S	91W	21	SE	SW	NW	--	--	--	--
North Fork of the Gunnison River											
Fire Mountain Canal		0	0						--	--	--
Fire Mountain Canal	23	13S	90W	8	SW	SW	SW	--	--	--	--
Fire Mountain Canal	23	13S	90W	8	SW	SW	SW	--	--	--	--
Fire Mountain Canal	23	13S	90W	8	SW	SW	SW	--	--	--	--

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Table 3.5-4
Water Rights Impact Summary

Water Right Name	Map #	Location						Overburden Thickness			
		TS	RNG	SEC	Q160	Q40	Q10		Alt. B	Alt. C	Alt. D
North Fork of the Gunnison River (continued)											
Somerset Mine Well	24	13S	90W	8	SE	SW		--	--	--	--
Bear Well No. 1	25	13S	90W	8	SE	SE		--	--	--	--
Fire Mountain Canal	23	13S	90W	17	NW	NW	SW	--	--	--	--
Fire Mountain Canal	23	13S	90W	17	NW	NW	SW	--	--	--	--
Fire Mountain Canal	23	13S	90W	17	NW	NW	SW	--	--	--	--
Carrol Ditch	26	13S	90W	18	NW			--	--	--	--
New Majnik House Well	27	13S	91W	14	NE	SE	SE	--	--	--	--
Sell No. 1 Well	28	13S	91W	14	NE	SE	SE	--	--	--	--
Jenkins Ditch No. 1	29	13S	91W	15	SW	SW	SE	--	--	--	--
Jenkins Ditch No. 1	29	13S	91W	15	SW	SW	SE	--	--	--	--
Jenkins Ditch No. 2	30	13S	91W	15	SW	SE	NW	--	--	--	--
Jenkins Ditch No. 2	30	13S	91W	15	SW	SE	NW	--	--	--	--
Steward Ditch	31	13S	91W	15	SW	SE	SE	--	--	--	--
Bronish No. 1 Well	32	13S	91W	15	SE	NW	SE	--	--	--	--
Stephens Ditch	33	13S	91W	16	SE	SE	SE	--	--	--	--
Stephens Ditch	33	13S	91W	21	NW			--	--	--	--
Stephens Ditch	33	13S	91W	21	NW			--	--	--	--
Stephens Ditch	33	13S	91W	21	NW			--	--	--	--

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The companies successful in leasing the Iron Point Tract would develop mine plans complying with applicable federal and state rules and regulations, including stipulations of the coal leases.

Dewatering of the D coal seam could decrease flow in the vicinity of Hubbard Creek near, and upstream of the historic (now abandoned) Blue Ribbon Mine. Hubbard Creek in this area (T13S, R91W, Section 34) receives contribution from groundwater originating in the D seam. Surface water flow loss would be temporary; during mining, the D seam would be dewatered to allow for efficient and safe operations. Following mining, dewatering activities would be terminated, and groundwater levels should return to their approximate pre-mining condition. See Section 3.6, Groundwater, for additional discussion.

Water discharge from the mines to surface streams could impact the quality of water in the receiving streams. Mine effluent would be regulated, and any discharge to receiving streams would have to meet permitted effluent requirements. Concentrations of TDS, iron, manganese, and sulfate could be constituents likely to increase.

Subsidence resulting from longwall mining can potentially disrupt stream flow and ponds directly above the underground mine and within the angle of draw. Any temporary stream flow loss could affect the amount of water available for surface water diversion to water users downstream. Water rights diverted from Hubbard Creek and Terror Creek could be impacted. A water replacement plan would be required to address negative impacts to water rights, as discussed in Section 3.5.4, Possible Mitigation and Monitoring.

Within the Iron Point Coal Lease Tract, segments of Hubbard and Terror Creeks, as well as most of the Freeman Gulch channel, the lower segments of Sheep Corral Gulch, and Dove Gulch, flow through areas that have a "high to very high" subsidence potential. See *Figure 14, Subsidence Potential Map*. Impacts from subsidence to these drainages could include changes in drainage channel morphology resulting in changes to general surface gradients, which could cause cutting, pooling, soil erosion, and sedimentation.

Terror Creek Reservoir lies within the "very low to low" potential category; therefore, no direct impacts are anticipated. The Iron Point Coal Lease Tract boundary and the projected angle of draw do not extend to Terror Creek Reservoir. See *Figure 14, Subsidence Potential Map*.

Elk Creek Coal Lease Tract - Bear Creek and Elk Creek which are intermittent drainages, do not receive contributions to surface water flow from the D seam, because the D seam dips to the northeast, and the depth of overburden increases to between 1,500 and 2,500 feet under most of the Bear Creek and Elk Creek drainages. See *Figure 14, Hydrogeologic Cross-Section A-A'*. Dewatering of the D seam in Elk Creek Tract is not expected to decrease surface water flow. However, longwall mining in the Elk Creek Tract would likely require dewatering of the saturated D seam. Mine water would be stored in sumps. It would be discharged, or treated and discharged, to the North Fork of the Gunnison River. This would be a discharge of groundwater during mining operations; this discharge would not be tributary to the North Fork of the Gunnison River, since the groundwater gradient is to the northeast. Oxbow is presently dewatering the B seam as part of its ongoing operations at the Sanborn Creek Mine under provisions of an existing NPDES permit. A similar arrangement would be expected for the D seam mining in the Elk Creek Coal Lease Tract.

A segment of Bear Creek lies within the "moderate to high" subsidence zone. The remainder of the Upper Bear Creek drainage lies within the "low to moderate" subsidence zone. See *Figure 14, Subsidence Potential Map*.

The Elk Creek stream channel falls outside of the Elk Creek Coal Lease Tract boundary; however, a portion of Elk Creek in T12S, R90W, Section 32, lies within the angle of draw for mining in a "very low to low" subsidence zone. See *Figure 14, Subsidence Potential Map*.

Two small unnamed ephemeral drainages tributary to Hubbard Creek originate in the southwestern-most corner of the Elk Creek Coal Lease Tract and fall within the "high to very high" and "moderate to high" subsidence zones.

There is a potential for mine subsidence to cause changes in channel morphology, including minor head cutting, pooling, channel adjustment, etc. Surface tension cracks also have the potential to develop within and surrounding the drainages. These changes could cause increased soil erosion and sedimentation.

Given the intermittent and ephemeral nature of the drainages within the Elk Creek Coal Lease Tract, as well as their existing steep gradients, the thickness of overburden, and the natural geologic instability of the area, subsidence would have minimal impact to these drainages.

There is one surface water right located near the Elk Creek Coal Lease Tract. The Burtard Ditch is located north of the tract boundary and outside the angle of draw. Impacts to this water right are not expected.

Indirect Effects - No indirect effects on surface water are expected as a result of exploration activities or of mining within the Elk Creek Coal Lease Tract.

If leased, subsequent mining within the Iron Point Tract could lead to indirect effects on the Terror Creek Reservoir. These include potential impacts to the structural integrity of the impoundment due to mining induced seismicity. Available information suggests that there is greater risk from seismic activity generated from collapse of historic room and pillar mines in the Somerset area, than from proposed longwall operations. It is expected that subsidence associated with longwall mining near the Terror Creek Reservoir would occur readily behind the active mine face (see *Appendix K, Subsidence Evaluation*). Further definition of potential indirect impacts could be made with additional monitoring and evaluation of impoundment construction and integrity, and local geologic conditions.

3.5.3.4 Effects of Alternative B

Under Alternative B, it is assumed that longwall mining would be conducted under the perennial portions of Hubbard Creek and Terror Creek in the Iron Point Coal Lease Tract. Subsidence associated with longwall mining produces different effects than subsidence caused by room and pillar mining. As such, several investigations regarding the impact of longwall subsidence to perennial drainages in western coalfields were consulted.

One study in a Utah coalfield showed that subsidence fractures up to 7 feet wide formed in a stream channel where 300 to 500 feet of overburden was present (USGS, 1995). Water from the creek was intercepted and reportedly reached the mine level. Other effects included a

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change in the type of water present and a variation in the gain-loss characteristics of the drainage.

A second study in Utah was performed on a creek where 600 feet of overburden was present. In this case, there were no discernible impacts to stream flow, although minor channel adjustments were observed. The lack of observed impacts were attributed to the presence of a thick, well-developed alluvial system that served to buffer the impacts (Mattson, L.L and J.A. Magers, 1995, and USDA-FS, 1999).

At one Colorado mine, a drainage with perennial flow was subsided where about 1,100 feet of overburden was present. The drainage flowed across a portion of exposed sandstone bedrock in which a series of tension fractures formed. The fractures intercepted flow in the drainage for a short period. It was reported that the presence of a 600 foot thick shale unit between the mine level and the creek likely served to reduce the extent of impacts (R. Mills, 1999).

Given that there is only about 500 feet of overburden underlying Hubbard Creek and Terror Creek (see *Figure 13, D Seam Overburden Isopach*), coupled with limited development of alluvial systems, there would be high potential that the stream channels and stream flow could be affected by subsidence and subsidence-induced fracturing from longwall mining directly beneath such stream channels.

3.5.3.5 Effects of Alternative C

Effects of Alternative C would be the same as Alternative B except that extending the western boundary of the Elk Creek Tract to the Iron Point Tract boundary would add an area that drains to Hubbard Creek, and is located in the "high to very high" and "moderate to high" subsidence zones. Dewatering the D seam in this area could further impact Hubbard Creek. Impacts to water quality in the Elk Creek Coal Lease Tract would remain the same as Alternative B.

3.5.3.6 Effects of Alternative D

No subsidence would be allowed under Terror Creek or Hubbard Creek. Therefore, the effects of longwall mining as described in Alternatives B and C would not occur.

Subsidence effects to smaller drainages, such as Dove Gulch, Sheep Corral Gulch and Iron Point Gulch, as described in Section 3.5.3.3, Effects Common to All Action Alternatives, would remain the same. All other impacts, including effects from dewatering, effects on water quality, and impacts to water rights, would remain the same as Alternative C.

3.5.4 Cumulative Effects

Activities contributing to cumulative effects can be separated into several categories: mining, construction development, agriculture, water use, recreation, and logging. These activities are described in Section 1.9, Adjacent Activities.

Current mining activity in the North Fork of the Gunnison River valley includes the Bowie No.1 Coal Loadout, the Bowie No. 2 Mine, the Sanborn Creek Mine, the Terror Creek Coal Loadout, and the West Elk Coal Mine. The Bowie No. 1 Mine is permitted for mining, but is inactive. Cumulative effects to surface water from mining activities include minimal impacts to water quality on the North Fork of the Gunnison River, localized impacts to area streams from sedimentation, and water use via adjudicated water rights.

Construction development activity includes the upgrade of State Highway 133 and future housing development. Effects to surface water from these activities, and effects from railroad maintenance/improvements could also temporarily contribute to sedimentation in the North Fork of the Gunnison River.

Agriculture is an important and significant activity in the North Fork of the Gunnison valley. Cumulative effects to surface water quality would be minimal in the North Fork of the Gunnison River valley. Under state law, the mine cperator/lessee would be required to replace any water right injured as a result of mining activities. In addition, a Forest Service stipulation (which would be added to the BLM lease form) requires restoration of stream channels/drainages to protect stream flow in the event of damage.

Minimal logging is anticipated in this area in the future. Effects from logging would impact surface water quality and increase sedimentation. Recreation is fairly limited in the area due to the lack of developed recreational facilities. Hunting is the primary recreational activity in this area, and impacts to streams from four-wheeling activity can result in increased sedimentation and damage to drainage channels.

3.5.5 Possible Mitigation and Monitoring

Stipulations that affect surface water and serve to mitigate potential impacts on the Iron Point and Elk Creek Coal Lease Tracts include:

- Establishing a monitoring system to locate, measure, and quantify progressive and final effects of underground mining activities would be required under the mine permit issued from Colorado DMG;

- Restoring stream channels and protecting stream flow, in the event of adverse affects from subsidence would be a requirement of the lease;

- Water replacement is required under the Surface Mining Control and Reclamation Act (SMCRA). A water replacement plan for any injury that may be due to mining. Replacement sources may include, but would not be limited to, transfer of water rights, augmentation plans, long-term water use leases or compensatory storage. The plan should include all water sources; and,

- No surface occupancy or use would be allowed in wetland areas, floodplains, or riparian areas and this stipulation would be a requirement of the lease and exploration license.

A plan for assessing the existing integrity of Terror Creek Reservoir and a plan for monitoring the stability would be required.

Baseline monitoring for surface water quantity and quality should be continued on the lease tracts and exploration license area as would be required under the mine permit. Due to the potential temporary loss of baseflow in sections of Hubbard Creek from dewatering of the D seam in the Iron Point Coal Lease Tract, it is recommended that stream flow and water quality monitoring be continued at the existing Hubbard Creek locations.

At least one additional surface water monitoring site should be installed on Hubbard Creek, either above or below the sandstone outcrop located below the historic (now abandoned) Blue Ribbon Mine. Monthly instantaneous flow monitoring should be taken at a minimum. Continuous monitoring of flow would provide the best indication of baseflow and any impact to the surface water flow in Hubbard Creek resulting from dewatering the D seam.

Monthly monitoring of flow and quality should be established on Bear and Elk creeks above and below the expected zone of influence from mining the Elk Creek Coal Lease Tract, and this type of monitoring would probably be required under a future mine permit.

3.6 GROUNDWATER

Issue: *Identify and minimize impacts to water quality and hydrology to maintain the integrity of watersheds within and surrounding the lease tract areas. Maintain adequate flows to drainages and ditches above underground mining activity. Areas of concern include: the potential to alter existing hydrologic systems; alteration of downstream flow rates; alteration of existing springs and seeps; changes in water chemistry as a result of mining operations; and, impacts to water rights on Terror Creek, Hubbard Creek, Bear Creek, and Elk Creek.*

3.6.1 Introduction

The study area for groundwater hydrology includes the region within a 1 mile radius of the proposed coal lease tracts and the exploration license area. Particular attention was given to the area of potential subsidence induced impacts (see Figure 14, *Subsidence Potential Map*).

The analysis of groundwater hydrology includes wells, springs and seeps, and stockponds fed by springs. Springs are defined as flowing at a rate of greater than or equal to one gallon per minute (gpm). Seeps flow rates are less than one gpm or are not measurable.

Information for this evaluation was derived from the following sources:

- Groundwater quality and quantity data for area wells and springs from Bowie, Oxbow, USGS, and Hotchkiss Ranches, as well as on-the-ground site visits by the North Fork Coal EIS team.
- Water rights information within a 1 mile radius from the Iron Point and Elk Creek Coal Lease Tracts and Iron Point Exploration License area from the Colorado State Engineers Office, Division of Water Resources.
- Review of Bowie and Oxbow data, annual hydrology reports, permit applications, and consultant reports related to groundwater hydrology.
- Regional NEPA documents.
- Review of reports, data, and maps compiled by the USGS, Colorado DMG, Forest Service, and BLM.

3.6.2 Affected Environment

3.6.2.1 Regional Hydrogeology

The primary groundwater-bearing zones in the North Fork of the Gunnison River Basin occur in Quaternary alluvial, colluvial, glacial, and eolian deposits and Cretaceous bedrock. Alluvial deposits along the North Fork of the Gunnison River represent a major aquifer. The municipal water supply for the town of Paonia is derived from groundwater wells developed in alluvium along the North Fork of the Gunnison River. Alluvial water-bearing units are thickest in the axis of the drainage bottoms and are typically 100 feet or less in thickness. The water quality of the alluvial groundwater is calcium bicarbonate type and good quality. The TDS concentrations of the groundwater range from 43 to 2,300 mg/l with concentrations of sulfate, TDS, and manganese sometimes exceeding federal drinking water standards. Well yields from this zone range from 1 to 150 gpm and average about 20 gpm (Ackerman and Brooks, 1985).

Colluvial water-bearing units located on valley slopes are generally isolated and are limited in extent. These units are normally saturated seasonally and have a low storage capacity and yield. Most springs and seeps in the region issue from colluvial deposits underlain by less permeable bedrock. Seasonal spring discharge from colluvial deposits ranges from 0.2 to 20 gpm and averages 5 gpm (Ackerman and Brooks, 1985). Colluvial deposits do not represent an aquifer in the region, and no reported wells are developed in this zone; however, numerous seasonal springs and seeps issuing from these zones have been developed for livestock watering and support wildlife. Spring development is usually accomplished by construction of small stock watering ponds in area drainages.

The primary bedrock water-bearing zones in the North Fork of the Gunnison River basin are in the sandstone and conglomerate units and fractured zones of the Lower Cretaceous Burro Canyon Formation and Late Cretaceous Dakota Sandstone. Minor groundwater occurrence is reported in the Late Cretaceous Mancos Shale, Mesa Verde Formation, and Tertiary Wasatch Formation. Saturated bedrock units are generally confined in nature, except near outcrops where they are typically unconfined.

Well yields from the Burro Canyon Formation/Dakota Sandstone (undifferentiated) are generally greater than 10 gpm (Ackerman and Brooks, 1985). Groundwater from the Mancos Shale is unsuitable for drinking or agricultural use; however, well yields from this formation reportedly range from 0.5 to 15 gpm (Ackerman and Brooks, 1985). Wells completed in the Mesa Verde Formation typically yield less than 10 gpm (Ackerman and Brooks, 1985). Limited data from wells completed in the Wasatch Formation indicate yields as much as 25 gpm (Ackerman and Brooks, 1985). No data is available for other Tertiary age deposits in the region. Spring flow from the Mancos, Mesa Verde, and Wasatch formations ranges from 1 to 25 gpm, averaging 10 gpm (Ackerman and Brooks, 1985).

Water quality from bedrock wells is generally sodium bicarbonate/sulfate type with TDS concentrations ranging from 490 to 8,200 mg/l, averaging 2,569 mg/l. Concentrations of sulfate, TDS, manganese, and fluoride sometimes exceed federal drinking water guidelines (USEPA, 1994). Water collected from springs issuing from bedrock is calcium sulfate type with TDS concentrations ranging from 56 to 4,300 mg/l, averaging 1,956 mg/l (Ackerman and Brooks, 1985). Concentrations of selenium, sulfate, TDS, and manganese sometimes exceed federal drinking water guidelines (USEPA, 1994). See *Figure 19, Groundwater Hydrology*.

Recharge of the water-bearing zones is by seepage from area streams, direct infiltration of precipitation and snowmelt. Alluvial water-bearing zones are hydraulically connected with adjacent bedrock and intermixing of the two units with groundwater is likely (Ackerman and Brooks, 1985). The shallow alluvial and colluvial groundwater flow follows local topography. The regional bedrock groundwater flow direction is northeast following the regional geologic dip of about 5 degrees. Locally, bedrock groundwater flow paths follow topography and are affected by numerous drainages bisecting the region.

3.6.2.2 Mine Site Hydrogeology

Groundwater occurs within the proposed exploration license area and coal lease tracts in the Quaternary alluvial and colluvial deposits, Wasatch Formation, and Mesa Verde Formation.

Saturated alluvium along the North Fork of the Gunnison River and primary tributary drainages (Terror and Hubbard creeks) has been developed for industrial, domestic, and livestock use. Area well yields range from 5 to 120 gpm and average 17 gpm (Bowie, 1998 and Oxbow, 1999). Several domestic wells are located at the mouths of Terror and Hubbard creeks.

Oxbow utilizes an infiltration gallery for its main fresh water source. The gallery is established in the alluvium of the North Fork of the Gunnison River south of Sanborn Creek. The reported maximum withdrawal rate is about 50 gpm (Oxbow, 1999).

The alluvial groundwater resources in the North Fork of the Gunnison River, as well as in Terror and Hubbard creeks, are elevationally lower than the proposed mined coal seams and are outside the predicted zone of potential mine-induced impacts. Saturated alluvium is unconfined and is recharged primarily by seepage from rivers and streams and, to a minor extent, by discharge from water-bearing bedrock and direct precipitation. Groundwater flow gradient in the alluvium follows the local drainage topography.

Water-bearing colluvial deposits are found along the slopes of area drainages and on the gentle terrain of the ridge tops, as noted by the occurrence of numerous seasonal springs and seeps. These saturated deposits are perched, limited in lateral extent, and are not considered significant water resources. However, several local stockponds are constructed to collect the seasonal spring flow. Local springs and seeps issue from these zones during periods of high precipitation and snowmelt. Seasonal spring and seep flows range from less than 1 gpm to about 5 gpm and are reported to be dry from summer to spring except after major precipitation events. Direct precipitation and snowmelt recharge these deposits. Groundwater is unconfined, and the flow direction follows the local topography.

The Wasatch Formation is composed of interbedded sandstone, siltstone, shale, and claystone. Sandstone beds are generally thin and limited in lateral extent. The Wasatch Formation outcrops on the gentle ridge tops of the Elk Creek Coal Lease Tract and Iron Point Exploration License area. Groundwater occurrence has been identified from numerous seeps and springs. These springs are generally perennial and are associated with thin sandstone outcrops overlying shale or claystone beds. Flow rates typically decrease during the summer and fall seasons (personal communication with Dan Hudson of Hotchkiss Ranches).

Springs and seeps also issue from landslide deposits in the Wasatch Formation where slumping has juxtaposed permeable strata with low permeable material. Slumping features also form catchments that hold snowmelt runoff enhancing recharge potential. Springs that issue from landslide deposits are ephemeral, flowing only during the wet season and during periods of high precipitation (personal communication with Dan Hudson of Hotchkiss Ranches).

The saturated zones in the Wasatch Formation are considered perched and with limited storage potential. Due to the outcrop location and gentle terrain of Wasatch Formation, recharge is primarily from snowmelt and direct precipitation infiltration. Numerous (about 40) local stockponds are fed from springs issuing from the Wasatch Formation. See *Figure 19, Groundwater Hydrology*.

Based on mining and drilling data and spring and seep surveys, groundwater in the Mesa Verde Formation is limited to isolated sandstone beds in the barren and coal bearing members, the Rollins Sandstone member, various coal beds, and along fault and fracture zones. Low primary permeability and limited storage capacity of the Mesa Verde Formation hydrogeologic units limit potential groundwater resource development (Brooks, 1983). However, significant quantities of groundwater are reported where the Mesa Verde Formation is fractured (Brooks, 1983).

Bowie reports perched water-bearing sandstone zones between the Rollins Sandstone and C coal seam and above the D coal seam (Bowie, 1998). The D coal seam is apparently saturated on the west side of Hubbard Creek as indicated by numerous springs and seeps.

Exploration drilling and mining activity at the Oxbow Mine have indicated perched groundwater zones below the E coal seam, in the D coal seam below its outcrop/subcrop with Elk Creek, and in the clastic sequence overlying the C and B coal seams (Oxbow, 1999).

Numerous springs and seeps issue from sandstone beds in the upper Mesa Verde Formation in the proposed Iron Point and Elk Creek Coal Lease Tracts and Iron Point Exploration License area. Most of these springs are reported to be perennial (personal communication with J. Stover of Stover & Associates and Dan Hudson of Hotchkiss Ranches).

Spring flows range from less than 1 gpm to about 25 gpm with flow decreasing during dry seasons. Direct precipitation and snowmelt infiltration recharge these deposits. Seepage from local streams provides little recharge due the steep stream gradients and gaining character in the upper drainages where these units outcrop.

Groundwater is unconfined near outcrop and semi-confined to confined in deeper subsurface. Groundwater flow direction follows the local topography near drainages and flows to the northeast (regional geologic dip of about 5 degrees) in other areas.

A summary of the spring and seep data is presented in *Table 3.6-1, Spring and Seep Summary - Iron Point Coal Lease Tract and Exploration License Area*, and *Table 3.6.2, Spring, Seep and Pond Summary - Elk Creek Coal Lease Tract*. Locations are shown on *Figure 19, Groundwater Hydrology*.

The Rollins Sandstone member in the proposed coal lease tracts and adjacent areas is unsaturated near the outcrops and becomes saturated down dip to the northeast. The low primary permeability and storage of this unit preclude it as being a significant water-bearing unit. No known water supply wells in the area are developed in the Rollins Sandstone. Drilling and monitoring well data indicates that the Rollins Sandstone is confined with a groundwater flow gradient to the northeast, following the geologic dip of the strata. Infiltration from local drainages crossing outcrops recharges this unit.

Table 3.6-1
Spring and Seep Summary - Iron Point Coal Lease Tract and Exploration Area

Site	Location			Drainage	Flow Rate (gpm)	Origin	Pond or Wetland	Overburden Thickness (D-Seam)	Impact Designation (High, Moderate, Low[3])			
	Northing	Easting	Elevation						Alt. A	Alt. B	Alt. C	Alt. D
S-1	5526.56	16929.41	6990	B Gulch	0-0.94			50	--	--	--	--
S-2	13215.22	16737.20	7920	Freeman Gulch	0-1.88		Pond	1360	L	L	L	L
S-3	13019.03	16256.55	7920	Freeman Gulch	0-3.75			1360	L	L	L	L
S-4[1]	13782.00	15415.42	7880	Terror Creek	0-0.75		Pond P-4	1350	L	L	L	L
S-4a	13999.99	15513.73	7910	Terror Creek	0.36-1.88			1390	L	L	L	L
S-5[1]	14939.20	15962.65	7800	Sheep Corral	0.09-0.54		Pond P-5	1330	L	L	L	L
S-5a	14917.40	15798.79	7850	Sheep Corral	0.18-4.3			1390	L	L	L	L
S-8	6554.664	16515.24	7220	C Gulch	0-2.5			340	H	H	H	H
S-10	8766.37	13910.51	7550	Stevens Draw	0-2.5			750	M	M	M	M
S-11	10746.95	13909.31	7940	Stevens Draw	0			1260	L	L	L	L
S-12	5816.85	15363.64	7640	B Gulch	0			670	H	H	H	H
S-13	10401.77	21709.23	7500	Freeman Gulch	0-0.27			960	M-H	M-H	M-H	M-H
S-14	5818.85	13686.75	7080	Stevens Draw	0.06-1.25		Pond P-1	150	H	H	H	H
S-16[1]	14087.18	14486.89	7760	Terror Creek	0.06-18.75		Pond P-3	1230	L	L	L	L

Table 3.6-1
Spring and Seep Summary - Iron Point Coal Lease Tract and Exploration Area

Site	Location			Drainage	Flow Rate (gpm)	Origin	Pond or Wetland	Overburden Thickness (D-Seam)	Impact Designation (High, Moderate, Low^3)			
	Northing	Easting	Elevation						Alt. A	Alt. B	Alt. C	Alt. D
S-17	11942.72	20346.30	7080	Freeman Gulch	0-18.75	Kmv Ss bed		590	M-H	M-H	M-H	M-H
S-18[1]	15253.54	13958.37	7600	Terror Creek	0-3.75		Pond P-6	1120	--	L	L	--
S2-2	13881.46	22252.46	6760	Hubbard Creek	0-15.5			410	--	H	H	--
S2-3	12626.06	22125.28	6720	Hubbard Creek	0-1.25			340	L	H	H	--
S2-4	11445.35	24310.26	6520	Hubbard Creek	0			140	--	H	H	--
S2-5	10813.71	23746.01	6720	Hubbard Creek	0-0.83			310	L	H	H	--
S2-6	11802.38	23443.25	6660	Hubbard Creek	0-10.71			240	L	H	H	--
S2-7	12095.13	22870.02	6640	Hubbard Creek	0.37.5			270	L	H	H	--
S2-8	12209.00	22454.08	6680	Hubbard Creek	0-1			290	L	H	H	--
S32-2	21740.45	10954.91	7670	Terror Creek	0		Pond 32-2	1430	--	--	--	--
S32-6	17871.89	10737.03	7560	Terror Creek	0-12.1			1160	--	--	--	--
S32-7	22361.73	10617.82	7760	Terror Creek	0-6.05			1550	--	--	--	--
S33-1	21170.09	16656.08	7470	Dove Gulch	0-0.42			1270	--	L	L	--
S33-2	19540.30	17002.08	7570	Dove Gulch	1.09-30			1340	--	L	L	--
S33-4	16007.17	15120.64	7790	Sheep Corral	0		Pond 33-3	1370	--	L	L	--

Table 3.6-1
Spring and Seep Summary - Iron Point Coal Lease Tract and Exploration Area

Site	Location			Drainage	Flow Rate (gpm)	Origin	Pond or Wetland	Overburden Thickness (D-Seam)	Impact Designation (High, Moderate, Low^2)			
	Northing	Easting	Elevation						Alt. A	Alt. B	Alt. C	Alt. D
SP33-5	17531.09	13698.53	7760	Terror creek	0-2.5	Qls	Pond 33-5	1410	--	L	L	--
SP33-6	17552.48	12659.77	7860	Terror Creek	0-0.5	Kmv Ss	Pond 33-6	1260	--	L	L	--
S33-8	17151.92	13687.54	7800	Terror Creek	0-0.5		Pond 33-7	1400	--	L	L	--
S33-9			7440	Dove Gulch	0-3			1360	--	L	L	L
S34-1	20410.98	17472.58	7300	Dove Gulch	0.31-3.95			1110	--	L	L	L
SP34-2	20287.55	17726.19	7260	Dove Gulch	1.91-15		Pond 34-2 Wetland	1120	--	L	L	L
S34-3	20075.34	17928.33	7310	Dove Gulch	0.32-1.7			1130	--	L	L	L
S34-4	19950.26	18116.36	7280	Dove Gulch	1.03-3.95			1100	--	L	L	L
S34-5	19873.83	18422.79	7300	Dove Gulch	0.47-10.71			1120	--	L	L	L
S34-6	22333.91	214473.87	6540	Hubbard Creek	0			540	--	M	M	--
S34-7	16403.34	17421.77	7390	Sheep Corral	0-4.41			980	--	M-H	M-H	M-H
S34-8	20085.27	19128.26	7200	Dove Gulch	0		Wetland	1060	--	L	L	L
S34-9	20179.11	18975.42	7200	Dove Gulch	0.23-42.86		Wetland	1060	--	L	L	L
S34-10	17932.22	21425.65	6640	Dove Gulch	0-11			450	--	H	H	--
SP34-11	16898.56	16907.40	7420	Sheep Corral	0.84-18.75		Pond	1070	--	L	L	L

Table 3.6-1
Spring and Seep Summary - Iron Point Coal Lease Tract and Exploration Area

Site	Location			Drainage	Flow Rate (gpm)	Origin	Pond or Wetland	Overburden Thickness (D-Seam)	Impact Designation (High, Moderate, Low[3])			
	Northing	Easting	Elevation						Alt. A	Alt. B	Alt. C	Alt. D
S34-17	23261.81	21760.72	6600	Hubbard Creek	0-4.17			620	--	--	--	--
S34-18	22993.90	21640.04	6560	Point Gulch	0-1.5			570	--	--	--	--
S34-19	20296.42	21620.75	6480	Hubbard Creek	0-7.5			370	--	H	H	--
S34-20	18729.92	21884.18	6440	Hubbard Creek	0-0.58			280	--	H	H	--
S34-21	17674.15	22213.37	6440	Hubard Creek	0-10.71			250	--	H	H	--
S34-22	17814.92	21554.98	6720	Dove Gulch	0-35			510	--	M	M	--
S34-23	17990.88	21237.54	6680	Dove Gulch	0-75			460	--	H	H	--
S34-24	15960.28	22676.98	6380	Hubbard Creek				160	--	H	H	--
Pond				Terror Creek			Pond P32-3	1320	--	--	--	--
Pond				Freeman Gulch			Pond P-2 Wetland	n.a.	M	M	M	M
Pond				Terror Creek			Pond P33-7	1430	--	L	L	--
PD-82[2]	5570.26	7361.13	7580	Terror Creek			Pond	750	--	L	L	--
8-5[2]	7194.58	5334.93	7800	Terror Creek				1075	--	--	--	--
PD-22[2]	6896.47	6487.10	7520	Terror Creek			Ponds	875	--	--	--	--
7-9[2]	8135.16	4671.55	7800	Terror Creek				1250	--	--	--	--
7-1	10597.83	4851.19	7630	Terror Creek			Pond	1250	--	--	--	--

Table 3.6-1
Spring and Seep Summary - Iron Point Coal Lease Tract and Exploration Area

Site	Location			Drainage	Flow Rate (gpm)	Origin	Pond or Wetland	Overburden Thickness (D-Seam)	Impact Designation (High, Moderate, Low[3])			
	Northing	Easting	Elevation						Alt. A	Alt. B	Alt. C	Alt. D
7-2	10250.11	5432.70	7780	Terror Creek			Pond	1275	--	--	--	--
8-4[2]	7507.02	8514.07	7160	Terror Creek				400	--	--	--	--
PD-21[2]	7339.57	8782.60	7160	Terror Creek			Pond 8-4	275	--	--	--	--
PD-18[2]	11688.97	8008.01	7320	Terror Creek			Pond	775	--	L	L	--
SP5-A[2]	11705.71	7705.92	7320	Terror Creek	1 gpm	Kmv Ss bed	(P18) Wetland	800	--	L	L	--
5-1[2]	11605.24	6782.87	7400	Terror Creek	<1 gpm	Qc		900	--	L	L	--
S5-B	14806.89	9795.83	7230	Terror Creek	2-5 gpm	Kmv Ss bed	Red Hughes	800	--	--	M	--
6-6[2]	11766.31	5018.04	7880	Terror Creek				1250	--	--	--	--
PD-17[1,2]	6170.15	14032.92	7560	Terror Creek			Pond	1100	--	--	L	--
5-2[2]	13053.01	8803.25	7200	Terror Creek	1 gpm	Kmv Ss bed	Wetland	675	--	M	M	--

Notes:

1. Water Right
2. From Bowie No. 1 Spring Survey and Monitoring Network
3. Impact Designation is a qualitative assessment based on predicted subsidence impacts, preliminary mining plans, and potential mine dewatering and recharge.

Springs S-6, 7, 9 & 15 were eliminate during 1997 construction

Table 3.6-2
Spring, Seep and Pond Summary - Elk Creek Coal Lease Tract

Site	Location (GPS date)			Drainage	Flow Rate (gpm)	Origin	Pond or Wetland	Overburden Thickness (D-Seam)	Impact Designation (High, Moderate, Low[3])			
	Northing	Easting	Elevation						Alt. A	Alt. B	Alt. C	Alt. D
ECP-1	12408.15	37991.80	8040	Elk Creek	Goes dry	--	Runoff Pond	1800	L	L	L	L
ECSP-2	19033.35	36479.85	8290	Bear Creek	Perennial	Tw Ss bed	Pond	2400	--	L	L	L
ECSP-3	18884.01	35991.13	8200?	Bear Creek	Perennial	TW Ss bed	Pond	2325	--	L	L	L
ECSP4	13841.79	35390.17	8000	Fire Mtn.	Goes dry	Qls	Pond	1700	--	L	L	L
ECSP-5	18918.19	40222.65	7812	Elk Creek	Perennial	Tw Ss bed	Pond	2150	--	L	L	L
ECP-6	18805.27	40326.32	7800	Elk Creek	Goes dry	--	Runoff Pond	2100	--	L	L	L
ECSP-7	19224.62	39912.94	8858	Elk Creek	Perennial	Tw Ss bed	Pond Wetlands	2225	--	L	L	L
ECP-8	13252.39	40312.46	7950?	Elk Creek		--	Runoff Pond	1625	L	L	L	L
ECSP-9	19252.90	40253.62	8646	Elk Creek	Goes dry	Qls	Pond	2175	--	L	L	L
ECSP-10	19314.32	35547.48	8190	Bear Creek	Perennial	Tw Ss bed	Pond	2475	--	L	L	L
ECP-11	19392.57	35212.93	8244	Bear Creek	Goes dry	--	Runoff Pond	2500	--	L	L	L
ECSP-12	19263.54	35486.48	8125	Bear Creek	Perennial	Tw Ss bed	Pond	2450	--	L	L	L
ECSP-13	19591.55	39866.52	8435	Bear Creek	Perennial	Tw Ss bed	Pond	2300	--	L	L	L
ECP-14	5402.21	30892.71	7300	North Fork	Goes dry	--	Runoff Pond		--	--	--	--

Table 3.6-2
Spring, Seep and Pond Summary - Elk Creek Coal Lease Tract

Site	Location (GPS data)			Drainage	Flow Rate (gpm)	Origin	Pond or Wetland	Overburden Thickness (D-Seam)	Impact Designation (High, Moderate, Low[2])			
	Northing	Easting	Elevation						Alt. A	Alt. B	Alt. C	Alt. D
ECSP-15[1]	25054.24	35185.29	7458	Bear Creek	Perennial	Tw Ss bed		2500	--	--	--	--
ECP-16	19983.20	30877.92	7923	Bear Creek	Never dry	Tw Ss bed	Pond Wetland	1500	--	M	M	M
ECSP-17	25061.07	30831.17	7912	Lone Pine Creek	Perennial	Tw Ss bed	New Pond Wetland	2025	--	--	--	--
ECSP-18	196966.13	26500.94	7916	Bear Creek	Perennial	Tw Ss bed	Pond	1875	--	L	L	L
ECSP-19	19772.29	30395.86	8281	Bear Creek	Perennial	Tw Ss bed	Pond	1475	--	M	M	M
ECP-20	11914.16	36334.47	7740	North Fork	?	--	Runoff Pond	1650	L	L	L	L
ECSP-21	20109.27	30882.45	7800	Lone Pine Creek	Perennial	Tw Ss bed	Pond	1625	--	L	L	L
ECSP-22	25185.68	26399.71	8006	Hubbard Creek		Qls		2075	--	--	--	--
ECP-23	25350.31	30458.98	7710	Lone Pine Creek	Goes dry	--	Runoff Pond	2050	--	--	--	--
ECP-24	19515.87	35391.04	8150?	Bear Creek	Goes dry	--	Runoff Pond	2525	--	L	L	L
ECSP-25	22785.66	40490.32	8250	Elk Creek	Perennial	Tw Ss bed	Pond	2550	--	--	--	--
ECP-26	21470.92	40136.94	8100	Elk Creek	Goes dry	--	Runoff Pond	2475	--	L	L	L
ECP-27	25238.37	30862.60	7635	Elk Creek	Goes dry	--	Runoff Pond	2050	--	--	--	--

Table 3.6-2
Spring, Seep and Pond Summary - Elk Creek Coal Lease Tract

Site	Location (GPS date)			Drainage	Flow Rate (gpm)	Origin	Pond or Wetland	Overburden Thickness (D-Seam)	Impact Designation (High, Moderate, Low[3])			
	Northing	Easting	Elevation						Alt. A	Alt. B	Alt. C	Alt. D
ECSP-28	19669.15	26373.42	8271	Bear Creek		Tw Ss bed	Wetland	1775	--	L	L	L
EC-1[2]				Elk Creek		Mvf Ss		n.a	H	H	H	H
SP-1[2]	11176.25	54501.72		Sanborn Creek			Pond	n.a	--	--	--	--
SP-2[2]	13502.97	54999.94		Sanborn Creek				n.a.	--	--	--	--
SP-3[2]	12776.77	53785.60		Sanborn Creek				n.a.	--	--	--	--
SP-4[2]	14320.94	54966.21		Sanborn Creek			Pond	n.a.	--	--	--	--
SP-5[2]	14276.11	54397.37		Sanborn Creek				n.a.	--	--	--	--
SP-6[2]	12977.77	55407.05		Sanborn Creek			Pond	n.a.	--	--	--	--
SP-7[2]	5656.60	48712.42		Sanborn Creek			Pond	n.a.	--	--	--	--
SP-9[2]	5594.20	46217.00		Sanborn Creek				n.a.	--	--	--	--
SP-10[2]	6130.77	55977.28		Sanborn Creek			Pond	n.a.	--	--	--	--

Notes:
1. Drinking Water Source
2. From Oxbow Mining Spring Survey and Monitoring Network
3. Impact Designation is a qualitative assessment based on predicted subsidence impacts, preliminary mining plans, and potential mine dewatering and recharge.

n.a. - not applicable
Information from Hotchkiss Ranches and EIS team unless noted.

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Current and historic mining in the area have encountered groundwater in the coal seams and adjacent strata. See *Figure 3, Historic Coal Mines and Federal Coal Lease Locations*, for current and historic mine locations. The Bowie No. 2 Mine is developed in the D seam and reports inflows of less than 1 gpm (Bowie, 1998). The D seam in this area is above outcrop/subcrop with local streams.

The Sanborn Creek Mine is developed in the B and C seams with average inflows of 100 gpm and peak flows of 250 gpm near fractured zones. This mine is situated below the outcrop/subcrop of the North Fork of the Gunnison River.

The Oliver Mine was developed in the D seam mostly above the outcrop/subcrop with Elk Creek. Historic information indicates mostly dry conditions with inflows ranging from 0 to 6 gpm (Oxbow, 1999).

Seeps and springs issue from coal seam outcrops, particularly on the north and east sides of local drainages. The most notable site is located in middle Hubbard Creek drainage where springs and seeps from the D seam outcrops create a marshy area.

Increased groundwater flow potential is expected near fault and fractured zones in all of the water-bearing strata of the area. However, little information is currently available to confirm this, except where mining operations have crossed fault zones. As stated above, the Sanborn Creek Mine experienced peak inflow rates about 2.5 times greater than average rates when crossing faulted zones (Oxbow, 1999). The Bowie mines have been typically dry, even in fractured terrain.

3.6.2.3 Groundwater Quality

Bowie and Oxbow have collected groundwater quality data for the past several years. Bowie has long term data from monitoring wells and springs at the Bowie No. 1 Mine, on the west side of Terror Creek. Bowie has also collected baseline data from numerous springs and wells near the Bowie No. 2 Mine and within the Iron Point Coal Lease Tract.

Oxbow has collected limited baseline data on groundwater quality from their current fee areas for the Sanborn Creek Mine. Baseline data is not available from the Elk Creek Lease Tract area.

For the purpose of this document, the water quality data from the Sanborn Creek monitoring sites are assumed to be similar to the Elk Creek Lease Tract. It is important to note that the Oxbow and Bowie laboratory water quality parameters are slightly different and that the groundwater quality discussions vary accordingly.

A summary of water quality data is presented in *Table 3.6-3, Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes*. Locations of the monitoring sites are shown on *Figure 19, Groundwater Hydrology*. The following discussion considers average water quality data and parameters that exceed federal primary and secondary drinking water standards (USEPA, 1994).

Iron Point Exploration License Area and Coal Lease Tract - The groundwater quality in the Iron Point Coal Lease Tract and Iron Point Exploration License area varies depending on the geologic unit. The water quality from the alluvial monitoring wells located in the drainages

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Table 3.6-3
Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes

	Bicarbonate	Chloride	TDS	Sulfate	Aluminum (D)	Calcium	Iron (T)	Lead (D)	Magnesium (D)	Manganese (T)	Sodium (D)	Zinc (D)
Water Quality Std. (Mg/l)		250	500	250	0.2		0.3	0.015		0.05		5
Iron Point - Springs												
S-16												
No. of Samples	5	5	5	5	5	5	5	5	5	5	5	5
Minimum	107	0.5	140	5	0.03	18.2	0.03	0.01	3.2	0.0025	10.5	0.005
Maximum	159	5	190	12	0.17	35.1	0.49	0.02	6.5	0.017	18.2	0.02
Average	129.4	1.9	164	6.4	0.074	28.66	0.148	0.014	5.34	0.0061	15.44	0.012
Standard Deviation	20.5499	1.8166	24.08	3.1305	0.0586	6.537	0.1965	0.00548	1.2915	0.00628	3.0713	0.0076
S-17												
No. of Samples	4	4	4	4	4	4	4	4	4	4	4	4
Minimum	266	2	300	20	0.1	42	0.1	0.01	17.5	0.0025	3.83	0.005
Maximum	298	3	380	30	5.42	55	6.08	0.02	19	0.094	62.7	0.04
Average	280.25	2.5	342.5	27.5	2.5175	50.32	2.7975	0.0175	18.05	0.03787	47.7	0.0237
Standard Deviation	13.376	0.5774	35	5	2.6673	5.763	2.9769	0.005	0.6557	0.04175	10.67	0.0149
S33-2												
No. of Samples	3	3	3	3	3	3	3	3	3	3	3	3
Minimum	218	2	260	30	0.1	29.1	0.04	0.02	6.5 0.0025	0.0025	59.3	0.005
Maximum	272	4	340	60	0.64	42.9	0.52	0.1	9.2	0.013	75.7	0.02
Average	244.333	2.6667	306.7	43.3333	0.3067	38.27	0.2533	0.04667	8.1667	0.00717	67.9	0.0117

Table 3.6-3
Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes

	Bicarbonate	Chloride	TDS	Sulfate	Aluminum (D)	Calcium	Iron (T)	Lead (D)	Magnesium (D)	Manganese (T)	Sodium (D)	Zinc (D)
Water Quality Std. (Mg/l)		**250**	**500**	**250**	**0.2**		**0.3**	**0.015**		**0.05**		**5**
Standard Deviation	27.0247	1.1547	41.63	15.2753	0.2914	7.939	0.2444	0.04619	1.4572	0.00535	8.2292	0.0076
S34-9												
No. of Samples	3	3	3	3	3	3	3	3	3	3	3	3
Minimum	250	7	400	90	0.11	49.4	0.09	0.02	12.1	0.0025	76.4	0.005
Maximum	290	9	460	100	25.5	75.2	27.8	0.1	18.2	0.545	86.5	.011
Average	275.333	7.6667	426.7	93.3333	8.6033	60.47	9.3367	0.04667	14.6	0.18617	80.733	0.04
Standard Deviation	22.0303	1.1547	30.55	5.7735	14.633	13.29	15.99	0.04619	3.1953	0.31079	5.2033	0.0606
SP34-2												
No. of Samples	3	3	3	3	3	3	3	3	3	3	3	3
Minimum	48	0.5	90	5	0.09	11.1	0.08	0.02	3.7	0.0025	3.4	0.005
Maximum	265	4	320	50	0.92	40.5	0.76	0.02	8.4	0.041	81	0.01
Average	184	2.8333	236.7	31.6667	0.4733	29.13	0.4333	0.02	6.7	0.0185	48.733	0.0083
Standard Deviation	118.495	2.0207	127.4	23.6291	0.4186	15.79	0.3408	0	2.6058	0.02006	40.416	0.0029
Iron Point - Alluvial Wells												
AW-1												
No. of Samples	7	7	7	7	1	1	7	1	2	7	1	1
Minimum	453	38	3100	1830	0.33	126	0.13	0.02	200	0.005	886	0.03

Table 3.6-3
Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes

	Bicarbonate	Chloride	TDS	Sulfate	Aluminum (D)	Calcium	Iron (T)	Lead (D)	Magnesium (D)	Manganese (T)	Sodium (D)	Zinc (D)
Water Quality Std. (Mg/l)		**250**	**500**	**250**	**0.2**		**0.3**	**0.015**		**0.05**		**5**
Maximum	657	79	8710	8330	0.33	126	1.69	0.02	543	0.16	886	0.03
Average	561.286	58	5920	4097.14	0.33	126	0.7357	0.02	371.5	0.039	886	0.03
Standard Deviation	89.8864	16.533	2365	2313.73	0	0	0.4899	0	242.5	0.05658	0	0
AW-3												
No. of Samples	7	7	7	7	1	1	7	1	1	7	1	1
Minimum	615	46	1750	760	0.4	206	0.78	0.02	176	0.051	233	0.03
Maximum	1100	136	2440	960	0.4	206	27.5	0.02	176	0.14	233	0.03
Average	817.143	86.286	2187	887.143	0.4	206	12.684	0.02	176	0.10414	233	0.03
Standard Deviation	202.92	38.504	232.2	65.5017	0	0	8.7624	0	0	0.02942	0	0
AW-4												
No. of Samples	7	7	7	7	1	1	7	1	1	7	1	1
Minimum	609	49	3810	2120	0.12	327	0.1	0.02	227	0.183	430	0.03
Maximum	790	63	5330	3220	0.12	327	0.45	0.02	227	1.21	430	0.03
Average	679	55.429	4517	2501.43	0.12	327	0.2514	0.02	227	0.61886	430	0.03
Standard Deviation	79.7433	5.0615	631.4	412.247	0	0	0.1345	0	0	0.36248	0	0
AW-5												
No. of Samples	7	7	7	7	1	1	7	1	1	7	1	1

Table 3.6-3
Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes

	Bicarbonate	Chloride	TDS	Sulfate	Aluminum (D)	Calcium	Iron (T)	Lead (D)	Magnesium (D)	Manganese (T)	Sodium (D)	Zinc (D)
Water Quality Std. (Mg/l)		**250**	**500**	**250**	**0.2**		**0.3**	**0.015**		**0.05**		**5**
Minimum	566	29	5380	1840	0.08	317	0.1	0.04	635	0.009	525	0.05
Maximum	768	52	6690	4550	0.08	317	0.47	0.04	635	0.02	525	0.05
Average	702.143	39.571	5931	3514.29	0.08	317	0.2671	0.04	635	0.01343	525	0.05
Standard Deviation	65.7329	8.7912	483	846.46	0	0	0.1451	0	0	0.00395	0	0
AW-6												
No. of Samples	7	7	7	7	1	1	7	1	1	7	1	1
Minimum	278	71	3640	1740	1.04	257	0.24	0.02	320	0.015	497	0.04
Maximum	386	120	4360	2510	1.04	257	1.03	0.02	320	0.29	497	0.04
Average	352.571	89.857	3973	2205.71	1.04	257	0.5586	0.02	320	0.13286	497	0.04
Standard Deviation	37.1701	19.222	283.2	276.276	0	0	0.3264	0	0	0.09839	0	0
Iron Point - Drill Holes												
DH-15												
No. of Samples	8	8	8	3	0	0	8	0	0	8	0	0
Minimum	441	23	1140	5	0	0	0.17	0	0	0.0025	0	0
Maximum	1200	28	1270	30	0	0	0.93	0	0	0.028	0	0
Average	1016.38	24.875	1191	18.33	0	0	0.435	0	0	0.028	0	0
Standard Deviation	237.558	1.8077	40.16	13.67	0	0	0.258	0	0	0.01106	0	0

Table 3.6-3
Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes

	Bicarbonate	Chloride	TDS	Sulfate	Aluminum (D)	Calcium	Iron (T)	Lead (D)	Magnesium (D)	Manganese (T)	Sodium (D)	Zinc (D)
Water Quality Std. (Mg/l)		250	500	250	0.2		0.3	0.015		0.05		5
DH-16												
No. of Samples	8	8	8	8	0	0	8	0	0	8	0	0
Minimum	987	23	2890	1290	0	0	0.78	0	0	0.11	0	0
Maximum	1200	34	3330	1520	0	0	14.4	0	0	4.03	0	0
Average	1104.63	29.75	3171	1418.75	0	0	3.9725	0	0	0.7	0	0
Standard Deviation	62.4475	3.7702	153.8	85.5966	0	0	4.3934	0	0	1.35154	0	0
DH-25												
No. of Samples	8	8	8	8	0	0	8	0	0	8	0	0
Minimum	1730	77	2200	30	0	0	0.54	0	0	0.03	0	0
Maximum	2640	110	3280	600	0	0	1.97	0	0	0.091	0	0
Average	2396.25	99.625	2963	257.5	0	0	1.1213	0	0	0.0505	0	0
Standard Deviation	305.705	13.12.5	333.9	224.101	0	0	0.5724	0	0	0.0208	0	0
DH-34C												
No. of Samples	8	8	8	8	0	0	8	0	0	8	0	0
Minimum	118	0.5	100	5	0	0	0.1	0	0	0.005	0	0
Maximum	156	4	190	20	0	0	2.01	0	0	0.041	0	0
Average	138.375	1.9375	162.5	11.375	0	0	0.52	0	0	0.01125	0	0

Table 3.6-3
Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes

	Bicarbonate	Chloride	TDS	Sulfate	Aluminum (D)	Calcium	Iron (T)	Lead (D)	Magnesium (D)	Manganese (T)	Sodium (D)	Zinc (D)
Water Quality Std. (Mg/l)		**250**	**500**	**250**	**0.2**		**0.3**	**0.015**		**0.05**		**5**
Standard Deviation	15.5374	1.1476	31.05	5.80486	0	0	0.6497	0	0	0.01237	0	0
DH-39												
No. of Samples	8	8	8	8	0	0	8	0	0	8	0	0
Minimum	545	16	780	190	0	0	0.3	0	0	0.057	0	0
Maximum	603	20	900	260	0	0	25.5	0	0	0.313	0	0
Average	576.375	18.375	841.3	216.875	0	0	10.806	0	0	0.15775	0	0
Standard Deviation	20.7911	1.4079	42.57	24.0442	0	0	9.2314	0	0	0.10497	0 0	
DH-49												
No. of Samples	8	8	8	8	0	0	8	0	0	8	0	0
Minimum	496	14	700	180	0	0	0.2	0	0	0.0025	0	0
Maximum	1540	20	2540	690	0	0	47.8	0	0	0.738	0	0
Average	864.625	16.625	1385	363.25	0	0	11.595	0	0	0.18769	0	0
Standard Deviation	433.054	2.2638	762.1	196.451	0	0	17.554	0	0	0.25408	0	0
ELK CREEK												
B-6'												
No. of Samples	29	29	30	28	--	29	30	?	29	5	29	29
Minimum	0	1	302	0.5	-	0.9	1.69	--	0.06 --	120	0.0025	

Table 3.6-3
Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes

	Bicarbonate	Chloride	TDS	Sulfate	Aluminum (D)	Calcium	Iron (T)	Lead (D)	Magnesium (D)	Manganese (T)	Sodium (D)	Zinc (D)
Water Quality Std. (Mg/l)		**250**	**500**	**250**	**0.2**		**0.3**	**0.015**		**0.05**		**5**
Maximum	3380	446	4890	820	-	49	176	--	29	--	1920	0.69
Average	971.59	130.93	1343	58.7634	-	11.45	34.46	--	4.21	10.32	503.97	0.13
Standard Deviation	827.47	122.07	1075	154.46	--	10.78	40.65	--	6.2	0.14	421.21	.19
H-10'												
No. of Samples	35	35	36	35	--	35	36	--	35	5	35	35
Minimum	940	4	2688	1	-	0.003	0.22	--	0	0.03	960	0
Maximum	2920	1070	4780	1140	-	116	39	--	42	0.16	1780	0.415
Average	2320.31	309.94	2983	94.17	-	14.53	8.39	--	7	0.10	1183.4	0.096
Standard Deviation	480.33	153.35	350.3	275.02	--	24.76	7.47	--	10.1	0.06	160.09	0.12
EC-1'												
No. of Samples	9	11	11	11	--	11	-	--	11	--	11	11
Minimum	73.2	0.0005	0.45	37.5	-	5E-04	0.224	--	0.001	--	0.0005	0.0005
Maximum	578.28	20	800	145	-	73.6	3.55	--	22.08	--	160	0.696
Average	434.85	8.67	503.6	89.55	-	37.06	0.99	--	14.44	--	110.47	0.07
Standard Deviation	163.89	6.93	227.1	30.89	--	26.99	1.12	--	6.42	--	58.08	.21
SC-1												
No. of Samples	22	23	23	22	-	22	23	--	22	8	22	22

Table 3.6-3
Selected Water Quality Summary - Springs, Alluvial Wells, Drill Holes

	Bicarbonate	Chloride	TDS	Sulfate	Aluminum (D)	Calcium	Iron (T)	Lead (D)	Magnesium (D)	Manganese (T)	Sodium (D)	Zinc (D)
Water Quality Std. (Mg/l)		**250**	**500**	**250**	**0.2**		**0.3**	**0.015**		**0.05**		**5**
Minimum	1452	1175	2330	1	-	17.2	0.29	--	6	0.014	2220	0.005
Maximum	4033	6680	11373	88	-	61	15.5	--	20	0.26	4200	4.8
Average	2889.55	3495.6	8136	19.54	-	25.11	4.2045	--	11.5	0.1075	3227.7	0.3356
Standard Deviation	806.535	1165.9	1934	23.653	-	9.011	3.7737	--	2.3995	0.07563	535.75	1.0067
SC-2[1]												
No. of Samples	22	22	22	22	-	23	22	--	22	8	22	22
Minimum	0	150	720	2	-	1	0.05	--	0.5	0.005	209	0.0025
Maximum	3841	8800	15290	100	-	326	13.9	--	35	0.104	5320	0.1
Average	1964.77	4607.7	10815	43.3182	-	22.89	3.2791	--	7.8227	0.02475	4057.2	0.0294
Standard Deviation	1315.74	2304.6	3579	30.3854	-	68.06	3.548	--	7.2219	0.03293	1292	0.0321
SC-3[1]												
No. of Samples	23	23	24	23	--	23	24	--	23	10	23	23
Minimum	336	6	408	14	-	46.5	0.27	--	17	0.1	116	0.0025
Maximum	567	117	1044	412	-	80	67.2	--	43	0.35	241	0.33
Average	451	25.61	651	133.09	-	57.82	17.29	--	23.9	0.21	157.48	0.04
Standard Deviation	64.2439	26.393	142.7	100.348	--	11.25	14.548	--	8.0599	0.0841	32.433	0.0715

Note: 1. Data for this station should be considered preliminary. It has been provided by Oxbow, but has not been verified against laboratory results.

below the Bowie No. 2 Mine (B Gulch and C Gulch) is calcium sulfate type. Water quality is poor with high concentrations of TDS, aluminum, iron, sulfate, and manganese. An alluvial monitoring well installed in the Freeman Gulch (DH-34C) has calcium bicarbonate type water with high concentrations of iron. The groundwater quality of the alluvial wells is similar to the surface water quality in the respective drainages indicating a connectivity between ground and surface water. The high sulfate concentration in ground and surface water of the mine drainages, B Gulch and C Gulch, indicate impacts from past mining activity. Historic waste coal materials and mine portals are located in the B and C gulches below the Bowie No. 2 Mine (personal communication with Greg Hunt, Bowie). Seepage from these sites likely impacts the TDS, sulfate, iron and manganese concentrations in the surface water and associated shallow groundwater.

Other monitoring wells are installed in the D coal seam overburden, D coal seam, and Rollins Sandstone. Two wells (DH-39 and 49) are installed in the overburden directly above the D seam. The water quality of these wells is sodium/calcium bicarbonate type with high concentrations of TDS, iron, sulfate, and manganese. The water quality from the well installed in the Rollins Sandstone (DH-34B) is sodium bicarbonate type with high concentrations of TDS, sulfate, iron and chloride. Water quality from wells installed in the D coal seam is sodium bicarbonate and sodium sulfate type with high concentrations of TDS, sulfate, iron, and manganese.

Spring water quality is similar throughout the area and is calcium/sodium bicarbonate type and typically with high concentrations of aluminum, iron, and manganese. Several springs had lead concentrations slightly above laboratory detection limits. Spring S-18 was the only site with sodium sulfate type water.

Elk Creek Coal Lease Tract - Site specific groundwater quality information is not available for the Elk Creek Coal Lease Tract area. The following discussion is based on groundwater quality data from the Sanborn Creek Mine area (Oxbow, 1999). It is assumed that the groundwater quality in the Sanborn Creek Mine area is similar to the Elk Creek Coal Lease Tract.

Monitoring sites include wells, springs and mine discharge. Groundwater zones are separated by geologic units including alluvial/colluvial, perched (clastic beds and coal seams in the Wasatch and Mesa Verde formations), D coal seam, B coal seam, and Rollins Sandstone. The alluvial/colluvial groundwater is collected from the Oxbow infiltration field installed in the North Fork of the Gunnison River alluvium. The groundwater from this site is calcium sulfate type with low concentrations of trace constituents. Generally, the quality of the alluvial/colluvial groundwater is good and suitable for domestic use with only minimal treatment (chlorination).

The perched water quality data is derived from eleven springs (EC-1, SP-1 through 7, and SP-9 through 11), and two monitoring wells (TC-1, and TC-2). The perched water quality is generally calcium sulfate to sodium bicarbonate type with moderately high concentrations of TDS, iron, and manganese.

Two wells (SC-3 and EC-6) and the Oliver Mine discharge spring are used to monitor D coal seam water quality. Water quality from the D coal seam is sodium bicarbonate type with high concentrations of TDS, iron, and manganese and sometimes sulfate. Water quality from wells (B-6 and H-10) installed in the historic Somerset Mine workings (B seam) and mine water inflow sites (MWM-1, MWS-A through D) is sodium bicarbonate type with high concentrations of TDS, iron, manganese, and sometimes chloride and sulfate.

The water quality from the two wells installed in the Rollins Sandstone (SC-1and SC-2) is sodium bicarbonate type with high concentrations of TDS, iron and manganese.

3.6.2.4 Seasonal Trends in Groundwater Quality

Iron Point Exploration License Area and Coal Lease Tract - Review of Bowie water quality data from monitoring wells and springs does not reveal any general seasonal trends in groundwater quality at the study area. This is likely due to the relatively short period of record for most sampling sites. Alluvial well data has been collected quarterly since 1997. Bedrock monitoring well data has been collected since 1995, and spring data has been collected sporadically since late 1997. Seasonal groundwater quality trends will likely become more defined when more consistent water quality data becomes available. Typically, seasonal trends include increased concentrations of TDS and dissolved constituents and high groundwater levels in the spring.

Elk Creek Coal Lease Tract - No site specific groundwater quality data is available for the Elk Creek Lease Tract.

3.6.2.5 Influence of Past and Current Activities on Groundwater Quality

Iron Point Exploration License Area and Coal Lease Tract - Past and current mining activities have affected groundwater quantity and quality. Current mining activities at the Bowie No. 2 Mine do not utilize any groundwater for operations. Fresh water for the operation comes from the Deertrail Ditch. The Bowie No. 1 and No. 2 mines are essentially dry, and dewatering has not been necessary. As a result, there have not been any impacts to groundwater due to water consumption or dewatering activities.

Historic mining activities at the King Mine in the drainages below the Bowie No. 2 Mine have apparently impacted the local alluvial groundwater quality. Two mine portals and associated coal fines/waste are located in the A and B/C Gulches. Seepage from these sites has caused high sulfate and other trace constituent levels in groundwater at the down gradient alluvial monitoring wells (AW-1, 3, 4, 5, and 6). No other impacts have been noted in this area.

Past and current activities other than mining have affected groundwater quality. Livestock grazing causes minor impacts to springs and seeps due to erosion and sedimentation and water quality, (i.e. fecal coliform). Unauthorized off-road vehicle use also causes erosion and sedimentation that effect spring areas. Individual domestic water wells and community water wells have had limited impact on groundwater quantity. Rural septic systems may impact local groundwater quality.

Elk Creek Coal Lease Tract - Due to the lack of groundwater monitoring at the Elk Creek Coal Lease Tract, impacts due to past and current mining activities are difficult to analyze. The Blue Ribbon Mine, located in Hubbard Creek, has been abandoned and reclaimed. Surface water quality in Hubbard Creek has not been adversely impacted (see Section 3.5, Surface Water) due to the historic Blue Ribbon Mine operations. As a result, it is not believed that groundwater quality has been impacted. A field survey of the site did not show any mining related impacts to the Hubbard Creek drainage. Mine discharge from the abandoned Oliver Mine (SP-8) and the Hawks Nest Mine (SP-11) is fair to good quality with somewhat elevated levels of TDS, iron, and manganese. These mines are located east of the Elk Creek Coal Lease Tract. See *Figure 3, Historic Coal mines and Federal Coal Lease Locations*.

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The active Sanborn Creek Mine has been storing discharge mine water in sumps in the B and C coal seams since 1992. The B and C seams were dry during active mining. Water quality data indicates that the stored mine water meets NPDES effluent limitations with minor treatment to reduce TDS concentrations (Oxbow, 1996). There may be some seepage from the storage sumps down dip in the coal horizon or to adjacent bedrock units; however the quality of the seepage is fair to good, and seepage rates are likely very small. The West Elk Mine, located south of the Elk Creek Coal Lease Tract, operates under an NPDES discharge permit with strict effluent quality standards. There are no known impacts to groundwater quality due to these operations.

3.6.2.6 Groundwater Use

Water rights and well records from the Colorado Division of Water Resources were reviewed for the area of the proposed coal lease tracts, exploration license area, and areas extending about 1 mile outside of these boundaries. Sites located within or west of Hubbard Creek were considered in the Iron Point Coal Lease Tract and Exploration License area. Those east of Hubbard Creek are considered in the Elk Creek Coal Lease Tract area. A summary of the groundwater rights and wells is presented in *Table 3.5-3, Water Rights Summary for Wells, Springs and Surface Water*, (see Section 3.5, Surface Water Hydrology). Locations of the water rights are shown on *Figure 18, Water Rights*.

Iron Point Exploration License Area and Coal Lease Tract - There are five adjudicated water rights associated with springs in the Iron Point Coal Lease Tract and Exploration License area. Four adjudicated water rights are on private surface (J&M Spring and Pipeline 1- 4) and one is on BLM surface (J&B Spring and Pipeline 5). These sites are used for stock watering purposes.

Six adjudicated water rights associated with wells are located in or around the Iron Point Coal Lease Tract and exploration license area. All but the Blue Ribbon well are located along the North Fork of the Gunnison River and are apparently installed in saturated alluvium. The Blue Ribbon well is located in Hubbard Creek adjacent to the historic Blue Ribbon Mine. This well is installed in the alluvium of Hubbard Creek and has not been in use since the Blue Ribbon Mine was closed.

The King Clay well is located on the West Fork Terror Creek. This shallow well is installed in the alluvium along West Fork Terror Creek and is for domestic use. The Peggy Seabloom well is located on the East Fork Terror Creek, about a mile west of Terror Creek Reservoir. This shallow well is installed in the alluvium along East Fork Terror Creek and is for domestic use.

Elk Creek Coal Lease Tract - There are no adjudicated water rights associated with springs in the Elk Creek Lease Tract area.

Two adjudicated water rights associated with wells are located near the Elk Creek Coal Lease Tract (Bear No. 1 and Somerset Mine wells). These wells are located along the North Fork of the Gunnison River and are apparently installed in saturated alluvium. All other active registered wells without water rights are used only for monitoring.

3.6.3 Environmental Consequences

3.6.3.1 Summary

Coal mine development in the Iron Point and Elk Creek Coal Lease Tracts and exploration activities on the Iron Point Exploration License area could potentially result in some impacts to area groundwater resources.

Longwall mining causes bedrock fracturing and land subsidence above longwall panels. By potentially providing pathways for groundwater to move downward toward the mined horizon, fracturing and subsidence may divert water from saturated horizons and surface water bodies above and adjacent to caved areas. Impacts to groundwater systems may potentially result in the decrease in natural discharge rates from springs and seeps or change water levels and yields in area wells. Some effects could be as follows:

- Mining would dewater the coal horizon and water-saturated horizons immediately above and below the coal horizon.
- Degradation of water quality when groundwater flows through active or abandoned mine workings.
- Transbasin diversion of groundwater resulting from dewatering of the coal seam.
- Water rights could be affected if area spring flows and associated pond levels and well water levels are diminished.
- Increased sedimentation of area springs from construction and use of surface facilities (exploration drill pads and associated access roads).
- Accidental fuel or solvent spills could impact shalllow groundwater locally.

The criteria for significant impacts refer to adverse impacts to the quality or quantity of groundwater utilized for important uses, such as domestic water supply, livestock watering, springs that recharge wetland/riparian areas or support wildlife habitat, and natural resource values.

It is important to note that subsidence induced impacts to groundwater resources were calculated from the reasonably foreseeable development scenarios and generalized overburden strata characteristics for the Iron Point and Elk Creek Coal Lease Tracts. It was also assumed that coal would be extracted to the limits of the lease tract boundaries using longwall mining. Actual mining plans could be different.

Exploration activities should not noticeably impact groundwater resources. The strata are not uniformly saturated, so there is little concern for inter-aquifer communication. The drill holes would be small diameter and would have little disturbance to the strata.

3.6.3.2 Effects of Alternative A (No-Action)

Direct Effects - Under this alternative, the coal lease tracts would not be offered for lease, and mine development would not occur. As a result, there would be no mining related impacts to groundwater resources in the Iron Point and Elk Creek Coal Lease Tracts or from exploration activities in the Iron Point exploration license area. Existing impacts to groundwater from past and current land uses would continue.

The Bowie No. 2 Mine and Sanborn Creek Mine would continue to operate under their current permits. The Bowie No. 2 Mine would develop north and east to the proposed Iron Point Coal Lease Tract boundary. As a result of this development, there is potential for subsidence related impacts to groundwater resources. Several seasonal springs in this area could be impacted, including S-8 and S-13 (see *Figure 14, Subsidence Potential Map*). The Bowie No. 2 Mine is expected to be dry, and no impacts to groundwater resources from dewatering are expected.

Oxbow would develop the Elk Creek Mine on fee (private) coal reserves. As a result of this development, there would be the potential for subsidence and dewatering related impacts to groundwater resources. The subsidence impact evaluation completed for this document indicates potential impacts to groundwater resources near the D seam outcrops in Bear and Elk creeks. Several seasonal springs in this area could be impacted including Elk No. 1 (see *Figure 14, Subsidence Potential Map*). Dewatering would temporarily disrupt local groundwater recharge and discharge. Some of this groundwater may be considered a transbasinal diversion where groundwater is diverted from its natural drainage pattern to the North Fork of the Gunnison River.

After mining, the mine voids would fill with groundwater to about pre-mining levels. The groundwater would be exposed to collapsed and abandoned mine workings, and the quality of the water may be impacted. The most likely impact would be an increased concentration of TDS, iron, manganese, and possibly sulfate. The groundwater flow direction in the D seam horizon is to the northeast, beneath Grand Mesa. There are no known wells or springs down-gradient of the Elk Creek Coal Lease Tract that would be affected by any possible groundwater degradation.

3.6.3.3 Effects Common to All Action Alternatives

Various mine induced subsidence parameters were analyzed for the Iron Point and Elk Creek Coal Lease Tract areas. These include:

- Maximum vertical displacement
- Tilt
- Horizontal strain
- Angle of draw
- Break angle

Subsidence induced impacts to groundwater resources are primarily related to the break angle. The break angle defines the zone of maximum tensile strain above a mining panel. Most subsidence induced cracks in the overburden and at the surface occur in the zone of maximum tensile strain. Subsidence induced impacts to groundwater resources are rated as very low to low, low to moderate, moderate to high, and high to very high. In general, subsidence impacts are considered high with overburden thickness less than 500 feet, moderate with overburden between 500 and 1,000 feet thick, moderate to low with overburden between 1,000 and 1,500 feet thick, and low to very low with thickness above 1,500 feet. *Figure 14, Subsidence Potential Map*, illustrates the potential zones of mining induced subsidence impacts to water resources. Two areas of high to moderate impacts have been identified for the Hubbard Creek and Terror Creek drainages.

Direct Effects - Iron Point Exploration License Area and Coal Lease Tract - Under Alternatives B, C, and D, the Iron Point Exploration License area would be granted and the Iron Point Coal Lease Tract would be offered for competitive leasing.

Completion of the exploration drilling program is not expected to cause impacts to groundwater resources.

Longwall mining development of the Iron Point Coal Lease Tract would induce subsidence of the overlying ground surface. The extent, severity, and potential impact to water resources due to subsidence is dependent on the thickness, composition, and geotechnical properties of the overburden, thickness of the mined coal, and mining plans. Mining would also result in dewatering of saturated zones of the mined horizon. Mined areas would likely refill with water to approximate pre-mining levels after mining operations cease which could impact groundwater quality.

Subsidence could potentially disrupt or alter springs, seeps, ponds, and change local groundwater levels directly above the underground mine and within the angle of draw. The only areas within the coal lease tract with a high to moderate potential for impacts are Hubbard Creek and Terror Creek. See *Figure 14, Subsidence Potential Map*.

The D coal seam outcrop in the Hubbard Creek drainage is saturated. Seeps and springs from the outcrop create a marsh in the valley floor near the historic (now abandoned) Blue Ribbon Mine. Mining of the D coal seam would dewater this zone and may temporarily dry the strata, springs, and seeps.

After mining, the eastern section of the mine would fill with groundwater to about pre-mining levels. The groundwater would be exposed to collapsed and abandoned mine workings, and the quality of the water may be impacted. The most likely impact would be an increased concentration of TDS, iron, manganese, and possibly sulfate. This would impact the water quality of the springs and seeps issuing from the D coal seam outcrop.

No groundwater rights are located in the areas of potential impacts. However, water rights associated with seeps and springs are considered surface water rights, and are discussed in Section 3.5, Surface Water Hydrology.

Direct Effects - Elk Creek Coal Lease Tract - Small areas in the southern portion of the Elk Creek Coal Lease Tract along the east side of Hubbard Creek and in Bear Creek have a high to moderate potential for subsidence induced impacts to water resources (*Figure 14, Subsidence Potential Map*). Most of the Elk Creek Coal Lease Tract has overburden thickness between 1,500 and 2,500 feet with low to very low potential for impacts.

It is believed that the D coal seam is saturated throughout most of the Elk Creek Coal Lease Tract. Mining would require dewatering of this zone. Mine water would likely be stored in sumps located in abandoned mine workings, treated if necessary, and discharged to the North Fork of the Gunnison River at a permitted outfall site. Mine discharge water quality would have to meet permitted effluent requirements. Mine dewatering and discharge may represent a transbasinal diversion of groundwater since the discharge point for the D coal seam groundwater is northeast of the North Fork of the Gunnison River drainage area. The estimated mine water discharge volume has not been determined.

After mining, the mine voids would fill with groundwater to about pre-mining levels. The groundwater would be exposed to collapsed and abandoned mine workings, and the quality of the water may be impacted. The most likely impact would be an increased concentration of TDS, iron, manganese, and possibly sulfate. The groundwater flow direction in the D coal seam horizon is to the northeast, beneath Grand Mesa. There are no known wells or springs down-gradient of the Elk Creek Coal Lease Tract that would be affected by any possible groundwater degradation.

Petroleum, oils, and lubricants are regularly used in mining operations. These materials may degrade discharge water quality if they are mishandled or abandoned underground and exposed to water passing through the mine. Any toxic or hazardous materials which are used underground should be removed from the mine prior to closure. It is assumed for this analysis that mining equipment would also not be abandoned underground.

No groundwater rights are located in the areas of potential impacts. However, water rights associated with seeps and springs are considered surface water rights, and are discussed in Section 3.5, Surface Water Hydrology.

Indirect Effects - The potential for indirect groundwater impacts in the study area is expected to be minimal. If mine employees choose to live in rural areas, private domestic wells would be drilled and septic systems would be installed. Appropriate state and county regulations would have to be followed, minimizing impacts to groundwater quantity and quality.

Methane release from coal mines would not be expected to impact domestic water wells, particularly in Garvin Mesa because the wells are below the coal seams to be mined. In the Garvin Mesa area, the coal has eroded away and does not have any contact with water below the outcrop of the Rollins Sandstone. The Rollins Sandstone is approximately 120 feet above Garvin Mesa.

Cumulative Effects - Mining at the Sanborn Creek and West Elk mines is currently dewatering coal bearing zones in the Mesa Verde Formation. Mining in the Iron Point and Elk Creek Coal Lease Tracts would continue to dewater the D coal seam zone of the Mesa Verde Formation. There may be a cumulative impact on water quality in the coal bearing zones of the Mesa Verde Formation. After mining ceases, mine voids would partially or completely fill with water and groundwater quality may be adversely impacted. This would add to water quality impacts from historic mines and when active mines are abandoned. It should be noted that the historic Hawks Nest and Oliver mines have had minimal impact to groundwater quality with elevated concentrations of TDS, iron, and manganese (Oxbow, 1999).

3.6.3.4 Effects of Alternative B

Completion of the exploration drilling program is not expected to cause impacts to groundwater resources.

Longwall mining development in the D coal seam of the Iron Point Coal Lease Tract would induce subsidence of the overlying ground surface and temporarily dewater the strata adjacent to the D coal seam. After mining, the D coal seam zone would likely flood to approximate pre-mining levels which could impact groundwater quality.

The southeast corner of the lease tract in the Hubbard Creek drainage is located in an area of high potential subsidence impacts with overburden thickness less than 500 feet. Nine seasonal springs are located in this area (S2-2, 3, 4, 5, 6, 7, 8 and S34-20, 21, and 24) and would likely be impacted. No perennial springs are located in this area.

Portions of Terror Creek would be subsided under this alternative; however, there are no springs identified in the high to very high subsidence zone in Terror Creek (see *Figure 14, Subsidence Potential Map*). Given the low overburden present, subsidence fracturing could interrupt groundwater seepage entering the drainages from saturated colluvial and alluvial material in the drainage bottoms.

Small areas in the southern portion of the Elk Creek Coal Lease Tract along the east side of Hubbard Creek and in Bear Creek have high to moderate potential for subsidence induced impacts to water resources. No known groundwater resources are located in these areas, and no impacts are anticipated. Most of the Elk Creek Tract has overburden thickness between 1,000 and 2,500 feet which would have moderate to very low potential for subsidence impacts.

Dewatering impacts and water quality impacts for Alternative B would be the same as those discussed in Section 3.6.5.3, Effects Common to All Action Alternatives.

3.6.3.5 Effects of Alternative C

Alternative C allows for multiple seam mining (B and D seams) in the Iron Point Coal Lease Tract with minor lease boundary adjustments.

Multiple seam mining would have a cumulative effect in regards to subsidence. (See *Appendix K, Subsidence Evaluation*.) The subsidence impacts evaluation calculates that maximum vertical displacement would be equal to the sum of the potential displacements from mining individual seams. The potential subsidence impacts to groundwater resources would essentially be the same as described for Alternative B due the great overburden thickness relative to the total mined thickness.

The expanded Iron Point Coal Lease area in Terror Creek is in a high potential subsidence area with overburden thickness of about 500 feet. Spring 5-2 is located in this area and could be impacted during mining operations.

It is believed that the B coal seam horizon is largely unsaturated in the Iron Point Lease Tract. As a result, active mine dewatering would not be necessary, and there would be no associated impacts. Post-mine flooding of the B coal seam is not expected because this horizon is naturally unsaturated. No additional groundwater quantity or quality impacts are expected apart from those described for Alternative B.

Direct impacts for the Elk Creek Coal Lease Tract in Alternative C would be the same as described in Section 3.6.5.4, Effects of Alternative B.

3.6.3.6 Effects of Alternative D

Alternative D allows for multiple seam mining (B and D seams) in the Iron Point Coal Lease Tract but with no subsidence impacts to Terror Creek and Hubbard Creek. Although the impact potential to these areas is expected to be very low as addressed in *Appendix K, Subsidence*

Evaluation, extra precautions would be required to eliminate any subsidence impacts to Terror Creek and Hubbard Creek. Other direct impacts to groundwater resources in Alternative D would be less because Terror and Hubbard creeks would not be subsided. There would be no effects to shallow groundwater in the drainage bottoms.

3.6.4 Possible Mitigation and Monitoring

3.6.4.1 Iron Point Exploration License Area

The Iron Point exploration activities are not expected to have any impact on groundwater resources. As a result, only site-specific monitoring measures would be required. A spring and seep inventory would be conducted in any corridors of the exploration area that would have new roads and drill pads. Field water quality and flow would be measured at any identified spring. Access roads and drill pads sites should be located to avoid spring and seep areas. See *Appendix I, Forest Service Stipulations - Iron Point Coal Lease Tract*, and *Appendix J, Forest Service Stipulations - Elk Creek Coal Lease Tract*. After the exploration activities are completed, the spring sites should be revisited and any changes should be recorded.

3.6.4.2 Iron Point Coal Lease Tract

Mining the Iron Point Coal Lease Tract would likely result in some subsidence induced impacts to groundwater resources. The Hubbard Creek drainage area has a high potential to be impacted. This includes the possible drying or flow change in springs and seeps in the main drainage and nearby tributary drainages. All of these springs are seasonal and typically flow during the spring and early summer months. The impacts to these sites would likely be temporary and after mining the normal spring flow would resume. In some cases, springs may issue from adjacent strata up or down hill from the original location. Because these springs are ephemeral, a temporary change in flow characteristics is not considered a significant impact, and no special mitigation measures would be necessary.

Dewatering of the D coal seam during mining would impact groundwater flow and discharge in the Hubbard Creek drainage. This impact would be temporary and the coal horizon would recharge after mine dewatering ceases. At this time, no mitigation is anticipated for this impact. However, if mitigation is deemed necessary to supplement wetland or stream recharge, the mining company may be able to pump water from the Blue Ribbon well and pipe water to affected areas or rechannel water from Hubbard Creek.

After mining is completed, the dewatered coal horizon would recharge with groundwater. The mine groundwater quality may be impacted resulting in elevated TDS and dissolved constituents. If necessary, discharge of this water from springs in Hubbard Creek could be treated to meet appropriate water quality standards. Currently, mine water treatment at the Sanborn Creek Mine requires only settling of the TSS levels before discharge.

A monitoring network to include several monitoring wells installed in the D coal seam and adjacent strata and alluvium would be needed. These wells should be located on the west side of Hubbard Creek across from the Blue Ribbon Mine. These wells would monitor the baseline groundwater levels and water quality in this zone prior to mining, monitor the potential effects of mine dewatering during mining, recharge after mining, and water quality changes. More consistent baseline data should be developed with year-round monitoring. It is also recommended that further hydrologic analysis be completed on Hubbard Creek to determine the interrelationship of ground and surface water and assess the potential for impacts due to mine dewatering. This would be expected to occur as part of the mine permit process with the Colorado DMG and OSM.

3.6.4.3 Elk Creek Coal Lease Tract

No impacts to springs or wells are expected as a result of mining the Elk Creek Lease Tract; therefore, no mitigation measures are listed here.

In the Elk Creek Coal Lease Tract, mine dewatering and discharge may represent a transbasinal diversion of groundwater since the discharge point for the D coal seam groundwater is northeast of the North Fork of the Gunnison River drainage area. Since this water-bearing zone does not support active surface discharge in the area, no significant impacts are expected, and no mitigation actions are anticipated.

After mining is completed, the dewatered coal horizon would recharge. The mine groundwater quality may be impacted resulting in elevated TDS and dissolved constituents. The groundwater quality impact would be limited in extent and naturally mitigated by dilution.

There is no monitoring network established in the Elk Creek Coal Lease Tract. If this tract is leased, the successful mining company would be required to conduct a spring and seep survey and establish a baseline monitoring program. Data should be collected periodically year-round (monthly or quarterly). The monitoring network should include springs and monitoring wells. Wells would be needed in the D coal seam, and adjacent strata east of Hubbard Creek, in Bear Creek, and on the east side of the lease tract in Elk Creek. In addition, several alluvial wells should be installed in Hubbard, Bear, and Elk creeks. It is anticipated that such additional hydrologic review would be part of the mine permit process with the Colorado DMG and OSM.

3.7 VEGETATION

Issue: *Address the impacts to vegetation as a result of mining and exploration activity. Areas of concern include: the potential effects on threatened, endangered, or sensitive plants; control of noxious weeds; and, the impacts on vegetation as a result of any subsidence.*

3.7.1 Introduction

Existing Forest Service vegetation mapping and associated resource information was used as a foundation upon which to complete this vegetation baseline discussion. Project areas not covered by the existing mapping, including a small portion of Forest Service and BLM administered lands, along with privately-held property, were mapped at the reconnaissance level by the EIS team to complete vegetation survey coverage for this project. The vegetation communities used for the original Forest Service mapping were retained for this effort. Discussions presented herein of the vegetation communities were developed as a result of the general data gathered during the reconnaissance survey, the soil survey completed for the area (Cryer and Hughes, 1997). Additional data sources are cited below.

The potential presence of Forest Service and BLM listed sensitive species (BLM State Director's Office, 1999; GMUG 1999) were evaluated in light of species elevational and habitat requirements assembled by the Colorado Natural Heritage Program (Johnson, 1999; Spackman et al., 1997).

3.7.2 Affected Environment

3.7.2.1 Upland Plant Communities

Eight upland vegetation types were mapped at the reconnaissance level within the project area. See *Figure 21, Vegetation Map.* These types range from tree-dominated communities to those dominated by grass and forb species. A "Bare" designation was also included.

The Oak Vegetation Community is essentially ubiquitous across the project area occurring on ridge slopes, along ephemeral drainages, and over level to moderately rolling mountain meadows. Near pure stands of Gambel oak (*Quercus gambelii*) dominate drier ridge slopes. Where the community occurs in larger meadows and along drainages, it is more of a mixed shrub community composed of a wide variety of shrub species. This is a reflection of more mesic site conditions and wetter soil moisture regimes. The dominant shrub species is Gambel oak. Other shrubs which can be co- or sub-dominant depending upon growing conditions include snowberry (*Symphoricarpos oreophilus* or *S. rotundifolius*) and serviceberry (*Amelanchier alnifolia*). Herbaceous species such as lupine (*Lupinus argenteus*), white-flowered peavine (*Lathyrus leucanthus*), and various upland sedge (*Carex*) species are common in the understory (Johnston, 1997). Chokecherry (*Prunus virginiana*) is also a common community component while small, sub-dominant aspen (*Populus tremuloides*) stands may become established in wetter areas where this community borders the aspen community.

Occurring across the project area over a variety of elevations and aspects is the Aspen Vegetation Type. This type inhabits less steep slopes overall than the other tree-dominated vegetation types on site, though its presence on somewhat steeper slopes under the proper soil conditions is not uncommon. It intergrades with most of the other vegetation types on site, excepting the Pinyon/Juniper, and characteristically has a more open, highly productive understory. The dominant tree species is aspen. Common understory species include Woods rose (*Rosa woodsii*), mountain brome (*Bromus marginatus*), elk sedge (*Carex geyeri*), white-flowered peavine, Fendler meadow-rue (*Thalictrum fendleri*), and American vetch (*Vicia americana*) (Johnston, 1997). Wetter expressions of this type, in depressions or adjacent to seeps and springs, often form transition wetland vegetation communities.

The Pinyon/Juniper Vegetation Community occurs on steep west- and southwest-facing slopes at elevations typically below 7,000 feet. Dominant species include Utah juniper (*Juniperus osteosperma*) and Rocky Mountain juniper (*Juniperus scopulorum*) in the tree stratum. Pinyon pine (*Pinus edulus*) is also present. Dominant understory species include Gambel oak, mountain snowberry, Indian ricegrass (*Oryzopsis hymenoides*), and annual grasses (Western Resource Development Corporation, 1982). Rock outcrops are a major component of this unit. The soils are typically shallow and droughty compared to the soils supporting the other tree-dominated vegetation communities.

Steep to very steep canyon walls along Hubbard Creek and its tributaries support the Spruce/Fir Vegetation Community. Elevations nominally range from 6,800 to 8,000+ feet. This community tends to be comparatively dense and supported by soils reflecting more mesic conditions. Dominant tree species include Englemann spruce (*Picea engelmannii*), Colorado blue spruce (*Picea pungens*), and subalpine fir (*Abies lasiocarpa*) at higher elevations.

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Dominant understory species include bearberry (*Arctostaphylos uva-ursi*) and a variety of other shrubs and herbaceous species common to the Oak Vegetation Community, but at lower densities. As with other vegetation communities dominating drainages, a comparatively narrow riparian zone including a small channel and associated wetland fringe is typically present. Rubble land is also common within this vegetation community.

The Douglas-fir Vegetation Community is found along the Terror, Hubbard, and Bear creek drainages at elevations around 7,000 feet or less where the narrow canyon drainages and rapid runoff potentials preclude the establishment of the Cottonwood Vegetation Community discussed below. This community may also be found growing on north-facing ridge slopes primarily bordering Bear Creek. The dominant tree species is Douglas-fir (*Pseudotsuga menzesii*). Common understory species include serviceberry, snowberry, oregon-grape (*Mahonia repens*), and heart-leaf arnica (*Arnica cordifolia*). This community can occasionally form broad transition zones, or ecotones, with the Spruce/Fir and Aspen communities resulting in more mixed vegetation types. The riparian areas common to the drainages of this community are similar to those of the Spruce/Fir type discussed above.

The Cottonwood Vegetation Community is limited to the south-central portions of Hubbard Creek at elevations below approximately 7,000 feet. Slopes are typically nearly level to level reflecting an overall wetter soil moisture regime as compared to the Douglas-fir and Spruce/Fir vegetation communities located adjacent to drainages. Common tree species include narrow-leaf cottonwood (*Populus angustifolia*) and box-elder (*Acer negundo*) with Douglas-fir, Englemann spruce, and juniper species occurring on side-slopes under drier soil moisture conditions. Aspen may also be present in topographic depressions or in deeper, more fertile soils. Understory shrub species include those adapted to more moist substrates such as chokecherry, raspberry (*Rubus idaeus*), and Woods rose. As a consequence of more level topography and decreased runoff potentials, the wetlands and Waters of the U.S. associated with this vegetation community are broader and more well developed as compared to drainages in other vegetation communities.

Scattered across the project area, the Grass/Forb Vegetation Community is associated primarily with nearly level to moderately sloping sites on a variety of aspects. Similarly, elevations vary. This community occurs as small natural clearings within other vegetation types, revegetated development disturbances, and heavily grazed meadows often associated with developed stockponds. Dominant vegetation includes a variety of native and introduced herbaceous species depending upon the origin of each delineation. Native species present include wheatgrasses (*Agropyron* sp.), bluegrasses (*Poa* sp.), needlegrasses (*Stipa* sp.), and a variety of penstemons (*Penstemon* sp.), as well as rushes (*Juncus* sp.) and spikerushes (*Eleocharis* sp.) bordering stock pond margins. Introduced species present, depending upon the disturbed site, include smooth brome (*Bromus inermis*), crested wheatgrass (*Agropyron desertorum*), Kentucky bluegrass (*Poa pratensis*), and alfalfa (*Medicago sativa*) along with a number of introduced weedy species at varying densities (Hayes Environmental Services, Inc., 1995).

The "Bare" cover designation includes rock slides, steep-walled cliffs, and other areas which support little or no vegetation due to the surface expression of geologic material. Bare areas are also associated with the boundaries of the Terror Creek Reservoir. These areas total a comparatively small acreage.

3.7.2.2 Noxious Weeds

A number of noxious weed species are known to be of concern with respect to the project area in Delta and Gunnison counties. These species include, but are not limited to, Russian knapweed (*Centaurea repens*), hoary cress (*Cardaria draba*), yellow toadflax (*Linaria vulgaris*), Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), and scotch thistle (*Onopordum acanthium*) (Calicut, 1999; Green, 1999). Typically, these species are aggressive and highly competitive with more desirable species. Species such as scotch and musk thistle, along with Russian knapweed, form dense colonies which may be difficult to eradicate.

Noxious weeds are prone to establishment on newly disturbed sites; county regulations require that these species must be controlled where they become newly established.

3.7.2.3 Threatened and Endangered Plant Species

One federally listed threatened and one endangered plant species occur in the region within which the project area is located. The Uinta Basin hookless cactus (*Sclerocactus glaucus*), a threatened species, occurs at elevations ranging from 4,500 to 6,000 feet on rocky hills, mesa slopes, alluvial benches, and in desert shrub communities. Listed as an endangered species, clay-loving wild buckwheat (*Eriogonum pelinophilum*) inhabits Mancos shale badlands in salt desert shrub communities at elevations ranging from 5,200-6,400 feet. Both have been found previously in Delta County. As was noted for the environmental assessments prepared previously for the lease tracts, no suitable habitat for these species occurs on either proposed lease area, or the exploration license area. Further, the elevation ranges within which these species are known to occur are, for the most part, below the lowest elevation found on the project area. These species would not be affected by the proposed leasing, mining, or exploration actions.

3.7.2.4 Sensitive Plant Species

Nine "forest sensitive" species are listed as potentially occurring on the GMUG, and Gunnison National Forests (GMUG, 1999). An additional 11 sensitive species are listed as potentially present on BLM lands administered by the BLM Uncompahgre Field Office (Colorado BLM State Director's Office, 1999). *Table 3.7.1, Sensitive Plant Species Summary*, presents a combined list of these species along with selected information concerning these species' habitat requirements, elevational ranges, and known presence in Delta and Gunnison counties (Ferguson, 1999; Johnson, 1999; LaFevere. 1999; Spackman et al., 1997).

The proposed project area ranges in elevation from 6,400 feet to approximately 8,500 feet. Six of the 20 listed species are adapted to habitat types occurring at elevations ranging from 8,500 to 14,000 feet, above the highest elevation of the proposed project area. In several cases, these species also occur in alpine habitat types such as peat mats, acidic ponds, fens, and alpine scree which are comparatively unique to higher elevations. The species in this category include molybdenum milkvetch (*Astragalus molybdenus*), smooth rockress (*Braya glabella*), round-leaf sundew (*Drosera rotundifolia*), wooly fleabane (*Erigeron lanatus*), white-bristle cotton-grass (*Euphorum altaicum*), and Colorado tansy-aster (*Machaeranthera coloradoensis*). Sandstone milkvetch (*A. sesquiflorus*), Dolores skeletonplant (*Lygodesmia doloresensis*), Eastwood monkey-flower (*Mimulus eastwoodiae*), and Paradox breadroot (*Pediomelum aromaticum*) are all known to occur at elevations lower than that of the project area and in habitats not present on the proposed lease tracts or exploration license areas.

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Table 3.7-1
Sensitive Plant Species Summary

Species Name	Agency Listing	Code[1]	Elevation Range (feet)	Habitat Characteristics	Known in Delta/Gunnison Counties	Potentially Present in Project Area
Gunnison milkvetch *Asragalus anisus*	USFS	FS	7,500-8,500	Dry or sandy clay soils, under low sagebrush	No/Yes	No
Grand Junction milkvetch *A. linifolius*	BLM	SS	4,800-6,200	Chinle and Morrison geologic formations	Yes/No	No
Molybdenum milkvetch *A. molybdenus*	USFS	FS	11,400-13,200	Rocky slopes, turf hillsides	No/Yes	No
Naturita milkvetch *A. naturitensis*	BLM	SS	5,000-7,000	Sandstone mesas in pinyon-juniper woods	No/No	No
San Rafael milkvetch *A. rafaelensis*	BLM	SS	4,400-6,500	Hills, washes, talus; in seleniferous soils	No/No	No
Sandstone milkvetch *A. sesquiflorus*	BLM	SS	5,000-55,00	Sandstone ledges, talus and sandy washes	No/No	No
Smooth rockress *Bray glabella*	USFS	FS	12,000-13,000	Calcareous substrates above timberline	No/Yes	No
Rocky Mountain thistle *Cirsium perplexans*	BLM	SS	4,500-7,000	Barren gray shale; adobe hills	Yes/No	No
Round-leaf sundew *Drosera rotundifolia*	USFS	FS	9,100-9,800	Peat mats, acidic ponds and fens	No/Yes	No
Wooly fleabane *Erigeron lanatus*	FS	FS	12,500-13,500	Steep alpine scree, talus slopes	No/Yes	No
White-bristle cotton grass *Eriophorum altaicum*	USFS	FS	9,500-14,000	Fens	No/Yes	No
Beard-tongue gila *Gilia penstemonoides*	USFS	FS	6,800-9,000	Walls, ledges, cliffs in gneiss, schist, shale	No/Yes	No

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Table 3.7-1
Sensitive Plant Species Summary

Species Name	Agency Listing	Code[1]	Elevation Range (feet)	Habitat Characteristics	Known in Delta/Gunnison Counties	Potentially Present in Project Area
Montrose bladderpod *Lesquerella vicina*	BLM	SS	6,000-7,200	Mancos shale, also sandstone soils, sagebrush step; distrubances	No/No	No
Colorado desert parsley *Lomatium cocinnum*	BLM	SS	5,500-7,000	Rocky soils from Mancos shale; shrub communities	Yes/No	No
Paradox Valley lupine *Lupinus crassus*	BLM	SS	5,000-5,800	Chinle and Mancos geologic formations; sparse vegetation	No/No	No
Dolores skeleton plant *Lygodesmia doloresensis*	BLM	SS	4,400-4,700	Red alluvial soil in juniper grassland	No/No	No
Colorado tansy-aster *Machaeranthera coloradoensis*	USFS	FS	8,500-12,500	Gravelly parks, slopes, rock outcrops up to dry tundra	No/Yes	No
Eastwood monkey-flower *Mimulus eastwoodiae*	BLM	SS	4,700-5,800	Shallow caves and seeps on canyon walls	Yes/No	No
Paradox breadroot *Pediomelum aromaticum*	BLM	SS	4,000-5,000	Red clay, clay outcrops, rocky soil, rock outcrops	No/No	No
Hapman's coolwort *Sullivantia hapemanii*	USFS	FS	7,000-10,000	Hanging gardens, wet cliffs, boulders in limestone and shale	No/Yes	Yes

Note: 1. FS=Forest Sensitive (U.S. Forest Service) SS=Sensitive Species (BLM)

Adapted from: Colorado BLM State Directors Office 1999, Ferguson 1999, GMUG 1999, Johnson 1999, Spackman et al. 1997

Three species, including the Grand Junction milkvetch (*A. linifolius*), Colorado desert parsley (*Lomatium coccinium*), and the Paradox Valley lupine (*Lupinus crassus*) are typically supported by soils derived from the Mancos, Chinle, and/or the Morrison geologic formations. These formations do not outcrop in or overlie the project area. In addition, the milkvetch and lupine are typically found at elevations lower than those characteristic of the project area. The Gunnison milkvetch (*A. anisus*) inhabits elevations common to the project area but is associated with dry or sandy clay soils underlain by granitic bedrock supporting low sagebrush (*Artemisia arbuscula*) vegetation communities. Neither surficial granitic bedrock nor low sagebrush is known to be present within the project area boundaries. Similarly, the lack of barren gray shales or adobe hills on site eliminates the concern for the Rocky Mountain thistle (*Cirsium perplexans*).

Naturita milkvetch (*A. naturitensis*), San Rafael milkvetch (*A. rafaelensis*), Montrose bladderpod (*Lesquerella vicina*), and Beard-tongue gilia (*Gilia penstemonoides*) occur at elevations and in habitats similar, at least in part, to those of the project area. However, the project area is well out of the known ranges of these species.

Hapman's coolwort (*Sullivantia hapemanii*) exhibits a preference for a habitat type which could be present at Hubbard Falls located in the SW¼, Section 14, T12S, R91W. Therefore, this species could be present in the northern-most portion of the project area.

3.7.2.5 Forest Resources

That portion of the forest within which the project area lies has not been subject to intensive logging or forest management practices. A small number of aspen sales have occurred in the past. No timber sales are scheduled for the future. Most desirable timber species occur on slopes too steep or are located in drainages too narrow for efficient logging to occur. Typically, slopes over 40 percent are not subject to commercial logging (Jones, 1999).

3.7.2.6 Range Resources

All or portions of seven federal grazing allotments occur within the lease tracts and exploration area. *Table 3.7-2, Summary of Forest Service and BLM Grazing Allotments,* depicts selected information related to these allotments. Stock for which these allotments are set aside include both cattle and sheep. Season of use typically ranges from late June to late September/early October on Forest Service managed land. Season of use on BLM managed land is more variable typically ranging from early spring to late spring through late fall (Jones, 1999).

3.7.3 Environmental Consequences

3.7.3.1 Summary

The construction of various borehole, shaft, and access road facilities would directly affect a maximum of approximately 33.5 acres of vegetation. The primary vegetation communities to be affected include the Oak and Aspen Vegetation types. The resulting loss of both timber and grazing resources is minimal, with the potential for a slight long-term increase in grazing potential possible following revegetation activities. No threatened or endangered plant species occur on site given these species' habitat requirements.

Table 3.7-2
Summary of Forest Service and BLM Grazing Allotments

Name	Agency Listing	Number	Dates of Use	Stock Type	Animal Unit Months (AUMs) or Ewe/Lamb Pairs
Coal Gulch	BLM	14517	5/15-7/1	Sheep	587 AUMs
Hubbard Creek	BLM	14516	5/10-6/10	Sheep	45 AUMs
Stevens Gulch Common	BLM	14513	10/1-5 6/1-25	Cattle	73 AUMs
Upper Terror Creek	BLM	14514	6/1-9/30	Cattle	59 AUMs
Caudemit Park S&G	USFS	NA	6/20-9/20	Sheep	1,000 ewe/lamb pairs
East Terror C&H	USFS	NA	6/26-10/5	Cattle	500 cow/calf pairs
Hotchkiss S&G	USFS	NA	6/21-9/20	Sheep	1,840 ewe/lamb pairs

3.7.3.2 Effects of Alternative A (No-Action)

Vegetation communities of the project area would continue to be subject to low levels of use in the form of grazing and other incidental activities such as firewood harvesting. No direct or indirect affects associated with the reasonable foreseeable actions listed for either the coal lease tracts or the exploration license area are anticipated. Future impacts to vegetation would parallel historic impacts barring any unforeseen developments or changes in land use policies. Endemic vegetation communities would continue to mature at natural rates while previously disturbed areas would be revegetated through time.

3.7.3.3 Direct and Indirect Effects Common to All Alternatives

A total of 33.5 acres is proposed to be disturbed by borehole, shaft, and access road construction under all action alternatives. The proposed locations of the exploration boreholes on the exploration license area are shown on *Figure 4, Iron Point Exploration Plan*. Eighteen boreholes (4.5 acres) are located in the Oak Vegetation Community, five (1.25 acres) in the Aspen Vegetation Community, two (0.5 acres) in the Grass/Forb Vegetation Community, and one (0.25 acres) would be located in either the Douglas-fir or Cottonwood Vegetation Community. The locations of the degasification boreholes (6.0 acres), exhaust shafts (3.0 acres), ventilation shafts (1.0 acre), and access roads (17.0 acres) are not known specifically. For the purposes of this section, it is assumed that the vegetation communities impacted by construction of the latter facilities would be proportionately the same as for the exploration boreholes, with minor impacts to the Spruce/Fir Vegetation Community factored in.

No timber sales are planned for the project area within the definable future. This is due, in part, to the characteristics of tree stands existing and the topography within which they have become established. Most tree stands, with the exception of aspen stands for which there is a limited market, are on slopes too steep (>40 percent) to log profitably. In addition, many stands occur in such narrow drainages, are so limited in size, and are so dispersed, that logging would be precluded for the same reason. However, the value of the timber resource which would be impacted by facility construction can be estimated, though it is highly unlikely that it would be logged or the dollar value of it realized in any other way. Given standard values for aspen and spruce/fir stands (Jones, 1999), and assuming that the values of cottonwood and Douglas-fir stands are similar, the value of the forest resource lost by clearing for subsequent facility construction could be approximately $4,300.

In terms of the range resources of the lease and exploration areas, the temporary clearing of 33.5 acres equals a loss estimated to be approximately 2.0 (cow/calf pair) animal unit months (AUMs) out of a total exceeding 500 AUMs (Jones, 1999). This temporary negative impact would be offset by a longer term positive impact following revegetation when, by reseeding the disturbed areas with grass species, the disturbed sites would be returned to a somewhat higher grazing value. Overall, however, both the positive and negative impacts are considered to be negligible given the comparative size of the area involved.

Weed infestations could occur in areas disturbed by the construction of various boreholes, shafts, and access roads. While it is uncertain whether this would take place, it is reasonable to assume that the potential exists given the natural invasive tendencies of these aggressive species whether by natural or man-induced vectors. The scattered nature of the proposed disturbances across the lease area give rise to further concerns with respect to the spread of these species over areas larger than the initial 33.5 acres to be disturbed. The mining plans summarized in Chapter 2, Alternatives Including the Proposed Action, do address this issue but do not include the necessary development of a weed control plan to be sublimated to the appropriate Delta and Gunnison County agencies. Mitigation is proposed to address this concern. The Forest Service requires that any reseeding be completed by a certified, weed-free source.

No threatened or endangered species present within the region are believed to occur within the project area due to these species' elevational and habitat requirements. Similarly, 19 of the 20 species listed as sensitive and occurring within the region by either the BLM or the Forest Service are believed to be absent from the project area for these same reasons. The presence or absence of Hapman's coolwort at Hubbard Falls should be documented in light of the potential effects from subsidence. Mitigation is proposed to address the question of whether this species exists on site and what future mitigation actions might be appropriate if it does.

3.7.3.4 Effects of Alternative B

Direct impacts to the vegetation resource are generally consistent across all alternatives. There is a potential to impact Hapman's coolwort at Hubbard Falls if subsidence occurs in this area. As noted in Section 3.4, Soils, the effect of subsidence would manifest itself as cracks forming on the earth's surface followed by a settling of the ground elevation as the geologic strata cave, at depth, behind the retreating longwall operation. Some cracks, devoid of vegetation, would remain on the surface at the conclusion of mining. The vegetation acreage which would be affected by cracking cannot be calculated but would likely be minimal considering the potential acreage involved and the natural ability of these cracks to revegetate. It is unlikely that a measurable acreage of vegetation would be lost given these considerations.

3.7.3.5 Effects of Alternative C

The affects of subsidence under this alternative would be the same as Alternative B except that adoption of multi-seam mining activities would increase lease acreage involved. With multi-seam mining, the depth to which geologic strata cave behind the advancing mining operation is greater. Given that the lease area under Alternative C is approximately 10 percent greater than under Alternative B, a comparatively larger acreage could be subject to the effects of subsidence.

3.7.3.6 Effects of Alternative D

Alternative D is identical to Alternative C except that subsidence would not be permitted under specific features such as Terror Creek, Hubbard Creek, the Curecanti-Rifle 230/345 kV electric transmission line, or the Terror Creek Reservoir. As a result, the affects on the vegetation communities extent would be the same only over a slightly smaller lease area. The affects of subsidence would still be greater under this alternative as compared to Alternative B.

Hapman's coolwort could be present at Hubbard Falls. Given the restrictions of mining within and beneath perennial streams on site, it is unlikely that this species or its habitat, if present, would be subject to any direct effects from underground mining.

3.7.4 Cumulative Impacts

Approximately 33.5 acres of vegetation may be affected by surface disturbances on the lease and exploration areas. Seventy acres of previous disturbances are associated with the existing Bowie No. 2 Mine and approximately 95 acres have been disturbed at the Sanborn Creek Mine. Approximately 10 to15 acres and 15 acres of additional disturbances are planned at these two mining operations, respectively. It is also estimated that about 150 acres have been disturbed by operations at the West Elk Mine to the south. The acreage of vegetation proposed to be directly affected within the cumulative affects area, by any alternative under consideration, represents an increase in disturbed area of approximately 10 percent. With respect to the total acreage of the project area, the proposed disturbances equal less than 1 percent of the total acres involved. The acreage affected by subsidence would not increase these totals measurably.

3.7.5 Possible Mitigation and Monitoring

Develop a weed control plan, addressing Delta and Gunnison County requirements, which would be employed to control the establishment and spread of identified noxious weeds. The plan should include the control of weeds during and following the cessation of mining operations and include such measures specifying the use of certified weed free seed and mulch products.

This stipulation would be effective, if followed during operations, in reducing the potential for weed invasions over the lease and exploration areas.

Conduct a survey of Hubbard Falls during June-July of 2000 to determine if Hapman's coolwort is present at this site. If present, develop a monitoring plan and, if necessary, a mitigation plan acceptable to the Forest Service for avoiding impacts to this species. This measure would be highly effective in achieving the stated goal of the measure and in increasing the potential for protecting this species if it exists on site.

3.8 WETLANDS

Issue: *Identify and minimize impacts to wetlands and Waters of the U.S. Areas of concern include: the acres of wetlands lost through direct impact; the changes in functions of values and* *wetlands and riparian areas as a result of mining and exploration activities; and, the potential effects from subsidence on these areas.*

3.8.1 Introduction

No formal delineations of wetlands or other Waters of the U.S. have been completed on either coal lease tract or the exploration license area. Seep and spring information was completed for the lease tracts and the exploration license area, but no wetlands data was collected. A formal wetlands delineation was completed for the proposed Elk Creek Mine portal location on private (fee) land.

To complete this section, a reconnaissance of readily accessible sites on, and bordering, the project area was made to record the essential characteristics of wetlands and other Waters of the U.S. typical of the lease tracts and exploration license area. These reconnaissance efforts were completed May 27 and June 18 and 19, 1999. The wetland delineation report completed for the portal area in June 1999 was also reviewed to support this section.

A more detailed analysis of the physical characteristics of seeps and springs can be found in Section 3.6, Groundwater.

3.8.2 Affected Environment

3.8.2.1 Wetlands

Wetland plant communities, other than those associated with seeps, springs, and stockponds, are typically confined to the borders of creeks and drainage channels. The soils of the wetlands located in the major drainage channels may exhibit light-colored matrices with little evidence of hydric indicators due to the continuous flooding and scouring typical of such channel gradients. Conversely, soils of the drainage channels having more gentle gradients are darker in color with chromas of less than 2 being common. Wetland hydrology is provided by channel flooding, lateral flow, and subirrigation. Wetland/upland transition zones are typically narrow to abrupt as a function of channel topography, though broad transition zones can be found in more gently sloping areas.

Wetland vegetation communities are comparatively simplistic in terms of diversity, typically being dominated by a few hydric species. The tree stratum, where it occurs, is dominated by narrow-leaf cottonwood (*Populus angustifolia*) and boxelder (*Acer negundo*) at lower elevations. Aspen *(Populus tremuloides*) is the common tree of wetlands occurring at higher elevations. Shrub species are essentially ubiquitous across the majority of the wetlands associated with creeks and drainage channels, although some small drainages located between narrowly spaced ridges do not support a shrub canopy. Dominant wetland shrubs include a variety of willows such as coyote willow (*Salix exigua*) and diamond willow (*Salix planifolia*), thinleaf alder (*Alnus tenuifolia*), and red-osier dogwood (*Cornus stolonifera*). Wetlands typically include a mix of these species although large, dense stands of willows or dogwood may be found in the more gently sloping floodplains of Hubbard Creek.

Herbaceous species occurring within these wetlands are variable and have become established in direct response to soil/hydrologic conditions reflecting soil depth, water holding capacity, and time of saturation. Along drainages where sandy soils and comparatively steep gradients predominate, few herbaceous species have become established to any degree. Wetland shrubs are the primary community component. Conversely, in more gently sloping drainages where soils have developed more fully and organic matter has accumulated, herbaceous species such as cow parsnip (*Heracleum lanata*), false Solomons-seal (*Smilacina stellata*), California false-helebore (*Veratrim californicum*), northwest cinquefoil (*Potentilla gracilis*), and a variety of sedge (*Carex*) and rush (*Juncus*) species have become established.

3.8.2.2 Other Waters of the U. S.

Drainage Channels - The major drainages of the project area are characterized by straight to curved channel beds. Braided formations and meanders are rare. The beds and banks are well developed and have formed in response to topographic gradients. These drainages exhibit gravel/cobble beds. Channel fines are typically sand-size. Smaller drainages in the project area have less well-defined beds and banks and are often vegetated to the channel borders. These channel beds often have a higher percentage of fines mixed with endemic gravels and cobbles.

Seeps, Springs, and Stockponds - These three features are common across the project area. Seeps and springs are naturally occurring and are primarily associated with coal seam outcrops at lower elevations and with sandstone lenses and colluvial/landslide deposits at higher elevations. They are more common at higher elevations and may exhibit seasonal or perennial flows. Recharge comes from direct precipitation or snowmelt infiltration. Seeps and springs on steeper slopes typically support vegetation communities dominated by willows along with a variety of grasses and forbs. Seeps and springs on nearly level to moderate terrain, particularly at higher elevations, support herbaceous communities dominated by such species as California false-hellebore, streamside bluebells (*Mertensia ciliata*), and various sedge species. A wetland shrub component may be conspicuously lacking at the higher elevations due in some cases to the dense, competitive herbaceous stratum. Aspen typically provides a tree component where one exists, though this species is not a consistent indicator of wetland seep or spring conditions.

Stockponds are man-made features which are filled either by spring or overland runoff. Wetlands occurring in association with developed stockponds are typically limited to a narrow bank fringe, though more extensive wetlands may develop in the drainages leading to stock pond depressions. The wetland fringe is dominated primarily by spikerush (*Eleocharis*) and rush (*Juncus*) species. Other species such as small-winged sedge (*Carex microptera*), clustered field sedge (*Carex praegracilis*), northwest cinquefoil and a variety of butter-cups (*Ranunculus* sp.) may also be present. A wetland shrub or tree stratum is rare, presumably as a direct result of animal use and/or soil compaction from earthwork by dozers or other similar equipment.

3.8.2.3 Riparian Zones

Riparian zones occur along project area drainages and are characterized by comparatively narrow vegetation communities requiring wetter soil hydrologic conditions than the surrounding uplands. The boundaries of riparian zones are limited in width by the steep topography associated with drainage systems. These zones may or may not include a recognized wetland component. A variety of tree species are usually associated with the riparian zones of the project area and, where occurring, the shrub component is denser than in the surrounding uplands due to soil moisture conditions. Recent studies in the semi-arid west comparing riparian areas with adjacent uplands showed that riparian zones support up to 400 percent more plant biomass, up to 200 percent more species richness, and contribute to large increases in density and species richness for birds when compared with upland areas (Clary and Medin, 1998).

Douglas-fir (*Pseudotsuga menzesii*) dominates the drier portions of the riparian zone at lower elevations. Utah juniper (*Juniperus osteosperma*) and Rocky Mountain juniper (*Juniperus scopulorum*) also occur on drier sideslopes along with shrubs such as Gambel oak (*Quercus gambelii*), snowberry (*Symphoricarpos oreophilus*), serviceberry (*Amelanchier alnifolia*), and chokecherry (*Prunus virginiana*), and red-osier dogwood. In more moist situations, tree species such as boxelder and narrow-leaf cottonwood are present. A spruce/fir community is common to riparian zones of higher elevations. This community is characterized by Englemann spruce (*Picea englemannii*) and Colorado blue spruce (*Picea pungens*). Understory shrub species components are similar to those of lower elevations, though species such as Woods rose (*Rosa woodsii*) and thinleaf alder are somewhat more prevalent. Aspen becomes a co-dominant tree species as elevation increases and is the dominant species in wetter zones of the higher elevations.

The herbaceous understory of the riparian zone is highly variable where upland species dominate. Where wetlands occur within this zone, the species present parallel those discussed in Section 3.8.2.1, Wetlands.

3.8.3 Environmental Consequences

3.8.3.1 Summary

The following text presents a discussion of potential impacts to the wetlands/riparian areas located within the project area. The impacts identified are those which can be expected to occur as a result of the proposed activities and alternatives detailed in Chapter 2, Alternatives Including the Proposed Action. Direct impacts include those associated with land clearing and grading to develop exploration and degasification boreholes, ventilation and exhaust shafts, and access roads. Indirect impacts, which vary by action alternative, are directly associated with potential subsidence dewatering in Hubbard and Terror creeks.

3.8.3.2 Effects of Alternative A (No-Action)

Wetlands would not be affected by the reasonable foreseeable actions listed for either lease area or the exploration license area under the No-Action Alternative. These resources would continue to exist in their endemic state, subject to natural variability and the limited affects of incidental human use. It is anticipated that wetland form and function characteristics would remain essentially constant. Some surficial impacts associated with grazing and limited logging are expected.

3.8.3.3 Direct Effects Common to All Alternatives

Twelve of the 26 proposed exploration borehole sites were visited during the opening phases of this project. See *Figure 4, Iron Point Exploration Plan*. Forest Service stipulations preclude siting any drill hole in wetland/riparian areas. Wetland avoidance is a positive approach to siting borehole or shaft disturbances given grading and drilling requirements as well as regulatory concerns. Specific clearance would be required if a borehole was sited in a wetland/riparian area. Should wetlands be disturbed in this manner, impacts would include vegetation clearing along with hydric soil removal and stockpiling. If fed by surface runoff, the potential hydrologic regime of the impacted wetland would not likely be affected. If, however, the wetland was supported by a groundwater source, this source could be negatively impacted by grading depending upon the required depth of excavation.

Approximately 17 acres of access roads could be constructed or upgraded as a part of the proposed exploration or mining-related activities. Stipulations would require placing roads outside wetland/riparian areas. As with proposed borehole and shaft disturbances, wetlands would be avoided where possible. It can be reasonably assumed, however, that a portion of the road acreage to be constructed or upgraded would occur along, or unavoidably intersect, project area wetlands. Isolated wetlands out of stream channels would be impacted in much the same manner as for borehole and shaft development. Wetlands along stream channels, as well as the channels themselves, would be subject to limited grading sufficient to enable vehicle access. Such grading would likely eliminate or greatly modify the wetlands within and immediately bordering the road right-of-way. It would also disturb to some degree the non-vegetated bed and bank associated with the stream. (Examples of these types of impacts currently exist within the project area.) It can be assumed that these impacts would occur along the major drainages such as Hubbard, Bear, and Terror creeks given the comparative size of these drainages.

The extent of these potential impacts cannot be assessed given the lack of wetland baseline data and the fact that some of the borehole, shaft, and access road locations are not known. The impacts would likely be limited, however, given the propensity to avoid wetland sites in light of construction and regulatory requirements. Reclamation following facility and road decommissioning would render these impacts short-term and mitigable given the adoption of a suitable wetland mitigation plan. Mitigation measures are proposed in Section 3.8.6, Mitigation and Monitoring, to address the lack of data and the inability to quantify these wetland impacts.

3.8.3.4 Effects of Alternative B

The proposed construction of boreholes, shafts, and roads follow plans that are the same for Alternatives B, C, and D. Therefore, direct impacts to wetlands are identical across all action alternatives. The impacts that vary by alternative are the indirect impacts associated with the surface and near surface effects of subsidence.

Subsidence associated with longwall operations results in a "cracking" of the soil surface above the retreating longwall operation as well as a caving, fracturing, and deformation of geologic strata between the surface and the coal seam being mined. Caving and fracturing occur in an ascending sequence immediately above the mined coal seam. Strata deformation occurs transitionally above the comparatively thin fractured zone and extends to the surface. Except in shallower overburden situations, deformation affects the majority of the geologic strata overlying the coal seam. While each of these effects could impact seeps and springs (and the stockponds and wetlands they support), coal removal, caving, and fracturing are likely to have the greatest impacts on these resources. As coal removal, caving and fracturing occur, and the geologic strata bearing the groundwater giving rise to seeps and springs is disrupted. With disruption, there is a high potential, especially where coal removal and caving occurs, to modify or eliminate the water sources supporting these features resulting in a drying impact to wetlands.

Figure 14, Subsidence Potential Map, depicts zones showing the potential for subsidence affects rated from "very low" to "very high" based on overburden depth and the presence of geologic hazards. As can be seen, the potential affects of subsidence are inversely proportional to overburden depth. Approximately 20 seeps and springs are located in zones for which the potential for subsidence is considered to be high to very high. These seeps and springs and their attendant wetlands and stockponds have a reasonable potential for being modified in some way, or eliminated, by subsidence.

With dewatering of the coal seam during operations, wetlands along Hubbard Creek may be affected, either in size, form, and/or function due to a reduction of seep and spring flow that contribute to these wetlands. This alternative assumes subsidence of Hubbard and Terror creeks. Section 3.5, Surface Water Hydrology, indicates that the creeks may be dewatered due to mining. Any loss of flow in the creeks would affect the wetland and riparian vegetation in the stream bottoms. Water loss could substantially reduce the size, form and function of the existing wetlands and riparian areas and the associated habitats. Seep and spring contributions to Hubbard Creek near the subcrop of the D coal seam may be reduced by an estimated less than 1 to 14 percent per year by mine dewatering depending upon annual stream flow volumes. A reduction of less than 1 percent would not likely result in a measurable effect to the wetlands within the drainage. No impacts would be expected to the shrub or tree strata given that these comparatively deep-rooted species are well established in the drainage. Some changes in composition of the herbaceous strata could occur, but would not likely be discernable.

A flow reduction of 14 percent could have a measurable effect on the Hubbard Creek wetlands/riparian areas. The wetland/riparian and boundary zone would likely shrink along the margins of the drainage. Dominant wetland herbaceous species inhabiting this zone and requiring saturated soils throughout the growing season would likely be replaced, in part, by wetland or upland plants adapted to less hydric soil moisture regimes. Recruitment of wetland shrub and tree species, particularly willows (*Salix sp.*), would likely cease and plant growth be curtailed somewhat. Established tall shrubs and trees along the drainage margins and on the higher alluvial bars would typically weather these conditions for the first few growing seasons and then begin to be affected depending upon the length of time that these conditions prevailed.

Following cessation of underground mining activities, the abandoned workings would fill with water and be expected to recover to the approximate conditions that existed prior to mining. When this occurs, seep and spring conditions would be expected to return to Hubbard Creek near the vicinity of the D coal seam subcrop.

3.8.3.5 Effects of Alternative C

The affects of subsidence under this alternative would be the same as Alternative B except that the adoption of multi-seam mining activities and the increased area to be mined would create greater impacts. With multi-seam mining, the thickness of geologic strata subject to caving and fracturing behind the retreating mining operation is somewhat greater. Therefore, the potential is greater in Alternative C than in Alternatives B and D to affect more seeps, springs, stockponds and their dependent wetlands.

3.8.3.6 Effects of Alternative D

Alternative D is identical to Alternative C except that subsidence would not be permitted under specific features such as Terror Creek, Hubbard Creek, or the Curecanti-Rifle 230/345 kV electric transmission line. The effects of subsidence would be the same as for Alternative C except that there would be no risk to the wetland/riparian areas in Hubbard and Terror creeks, and the number of seeps and springs potentially to be affected could be somewhat less.

3.8.4 Cumulative Impacts

The total acreage of wetlands disturbed previously by mining and other activities within the cumulative affects area is unknown. No wetland delineations are known to exist which would cover the existing mining disturbances, in total. Seep and spring surveys competed for the exploration and lease areas did not include the collection of typical wetland vegetation data. Past exploration, shaft and borehole drilling, portal construction, and general access road development activities could have impacted wetlands to an unknown, but limited degree on existing permitted mine areas.

Given the lack of information regarding past impacts to wetlands and the fact that no comprehensive wetland studies have been completed for the project area, cumulative impacts to the wetland resources cannot be calculated. It can be assumed that the exploration, drilling, and road construction activities proposed would affect these resources in a manner proportionate to the acreage affected by past operations. The indirect affects of subsidence on wetland resources, in the form of seeps and springs, are similarly unquantifiable with respect to cumulative affects.

Bowie has been issued a General Permit No. 21 by the U.S. Army Corps of Engineers to construct two sediment ponds and a portion of a road in association with the Bowie No. 2 Mine. The total disturbance, including both wetlands and other Waters of the U.S., is limited to 0.33 acres. This disturbance will be mitigated at a 1 wetland acre disturbed : 1 wetland acre created ratio.

Oxbow has been issued a General Permit No. 21 by the Corps of Engineers for the proposed portal construction in Elk Creek. This permit was issued on July 28, 1999.

3.8.5 Mitigation and Monitoring

Riparian and wetland areas present contain potential critical habitat for the southwestern willow flycatcher. According to the unsuitability criteria, affecting these areas by mining requires U.S. Fish and Wildlife Service Consultation. Mitigation measures may include avoidance of suitable habitat, establishing buffer zones or off-site mitigation (see *Appendix C, Unsuitability Analysis Report - Iron Point Coal Lease Tract*, *Appendix D, Unsuitability Analysis Report - Elk Creek Coal Lease Tract*, Section 3.9, Terrestrial Wildlife, and Section 3.10, Aquatic Resources/Fisheries).

Complete a delineation survey of wetlands and other Waters of the U.S. proposed to be disturbed by surface facilities, including roads, on both coal lease tracts and the exploration license area prior to surface disturbance. The delineation must be conducted according to Corps of Engineers guidelines and coordinated with any seep and spring survey to be conducted in the future. The report produced need include a map depicting the locations and acreages of the delineated wetlands and other Waters of the U.S. which would be affected. The lessors should then review this map and determine which impacts to wetlands and/or other Waters of the U.S. could be avoided or minimized and adjust surface disturbance locations accordingly. Permitting and mitigation planning would then follow. This measure would be highly effective in determining the acreage of wetlands and other Waters of the U.S. which could be affected, addressing avoidance and minimization requirements, and planning for mitigation, if necessary.

A survey and ongoing monitoring of seeps, springs, and stockponds within the lease tracts and exploration license area would be valuable. The delineation would include both wetland and other Waters of the U.S. features and be completed according to Corps of Engineers guidelines. The report would include a map depicting the locations of delineated wetlands and other Waters of the U.S. present, as well as information addressing the acreages and functions of the wetlands noted. This proposed mitigation measure would be a part of the permitting requirements of the Colorado DMG and the OSM for both the Iron Point and Elk Creek Coal Lease Tracts. This measure would be effective in providing a means to determine which seeps, springs, and stockponds are affected by subsidence and what follow-up wetland mitigation measures might be required.

3.9 TERRESTRIAL WILDLIFE

Issue: *Minimize the disruption to wildlife and wildlife habitats. Areas of concern include: the impacts to threatened, endangered, or sensitive species; impacts to deer habitat; loss of habitat and habitat effectiveness; and, impacts associated with continued and/or increased human activity.*

3.9.1 Introduction

This section addresses wildlife species of concern within the wildlife study area. The wildlife study area covered by this analysis encompasses the Elk Creek, Bear Creek, Terror Creek and East Fork of Terror Creek watersheds, as well as the lower and middle portions of the Hubbard Creek watershed. This area includes the entire coal lease tracts and the Iron Point Exploration License area as well as surrounding habitats. The extent and boundaries of the study area addressed by this document were delineated in consultation with Forest Service personnel. For most wildlife, direct, indirect, and reasonably foreseeable cumulative effects would be confined within the wildlife study area. However, for some species such as elk and deer and threatened and endangered species (bald eagle and peregrine falcon), larger regional population areas were evaluated to assess potential project related impacts.

Wildlife species and issues of concern addressed by this analysis were determined through consultation with state and federal agency personnel, a review of agency and public comments received during the EIS scoping process, and evaluation of potential species presence provided based on wildlife species' ranges and other pertinent information sources. Identified wildlife concerns are as follows.

- Minimizing impacts to wildlife and wildlife habitats.

- Potential impacts of subsidence to unique habitats such as wetlands, riparian areas, and rock outcrop and wildlife species dependent on these habitats.

- Potential impacts of subsidence to wildlife water sources (e.g., seeps and springs).
- Potential for impacts to big game species (elk, mule deer, black bear, mountain lion).
- Increased potential for elk and mule deer/automobile and train collisions with increased traffic levels
- Potential impacts to nesting golden eagle and other raptors.
- Potential impacts to state or federally listed threatened, endangered, proposed, and candidate species as well as BLM species of special concern and forest sensitive species.

Information regarding wildlife species and current habitat conditions within the study area was obtained from a review of existing published sources, Forest Service file information, and Colorado Division of Wildlife WRIS mapping data.

3.9.2 Affected Environment

3.9.2.1 Habitat Overview

Eight vegetation communities/wildlife habitats exist within the study area. See *Figure 21, Vegetation Map*. A "Bare" habitat type is also present within the study area. Oak brush habitat is essentially ubiquitous across the mid to lower elevation portions of the study area occurring on ridge slopes, along ephemeral drainages, and over level to moderately rolling mountain meadows. Stands of aspen are located on side-slopes and in drainages at the mid- to higher elevations. This habitat occurs on less steep slopes overall than the conifer communities. It intergrades with most of the other vegetation types on site, excepting pinyon/juniper. Pinyon/juniper habitat is located on steep west- and southwest-facing slopes at elevations generally below 7,000 feet. Areas of rock outcrop are a common habitat feature in pinyon/juniper. Steep to very steep canyon walls along Hubbard Creek and its tributaries support spruce/fir habitat. Elevations occupied by this conifer type nominally range from 6,800 to 8,000+ feet. Douglas-fir habitat is supported along the Terror, Hubbard, and Bear Creek drainages at elevations around 7,000 feet or less where the narrow canyon drainages and rapid runoff potentials preclude the establishment of the cottonwood habitat.

This community is also found on north-facing ridge slopes primarily bordering Bear Creek. Cottonwood habitat is restricted to the south-central portions of Hubbard Creek at elevations below approximately 7,000 feet. Slopes are typically nearly level to level reflecting an overall wetter soil moisture regime as compared to the Douglas-fir and spruce/fir vegetation communities located in the drainages. Grass/forb habitat is scattered across the study area and is associated primarily with nearly level to moderately sloping sites on a variety of aspects. This community occurs as small natural clearings within other vegetation types, revegetated development disturbances, and heavily grazed meadows often associated with developed stockponds. The "Bare" habitat designation includes rock slides, steep-walled cliffs, and other areas which support little or no vegetation due to the surface expression of geologic material. Bare areas are also associated with the boundaries of the Terror Creek Reservoir. Further discussion and characterization of these vegetation communities/wildlife habitats is provided in Section 3.7, *Vegetation*.

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3.9.2.2 Big Game

The project area occurs within Colorado Division of Wildlife Game Management Unit 521. Mule deer, elk, black bear, and mountain lion occur within the study area. Mule deer elk populations within the study area region exhibit seasonal movements to and from higher to lower elevation habitats, with most shifts in distribution occurring as a result of elevational migration in response to weather patterns and snow cover.

The majority of both coal lease tracts and the Iron Point Exploration license area represents summer range for mule deer while the lower elevations (approximately below 7,400 feet) are used as winter range (see *Figure 22, Mule Deer Range*). Preferred winter range areas are provided primarily by south and west-facing slopes of oak brush, mixed shrub, and pinyon-juniper habitats where browse is plentiful. Mule Deer Severe Winter Range and Winter Concentration Areas are located on the lowest elevation slopes where aspect and exposure limit snow accumulations. These areas are located along State Highway 133 and the North Fork of the Gunnison River below the confluence of Bear Creek and the North Fork of the Gunnison River (see *Figure 22, Mule Deer Range*). Severe Winter Range is defined as that part of the range where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten.

Elk winter range extends to higher elevations than mule deer winter range since elk are not as restricted by snow cover as are mule deer. Elk summer range also does not extend to as low elevations as mule deer summer range since elk prefer the higher and cooler elevations where aspen and spruce/fir habitats provide thermal and security cover. Elk winter range generally occurs below the 8,000 to 8,400-foot elevation level (see *Figure 23, Elk Range*) and is typified by oak brush and mixed shrub slopes where exposure limits snow accumulation. Elk Severe Winter Range and Winter Concentration Areas are located on the lower elevation slopes within the Elk Creek drainage and along State Highway 133 and the North Fork of the Gunnison River below the confluence of Bear Creek and the North Fork of the Gunnison River (see *Figure 23, Elk Range*).

Elk calving or production areas are defined as the portion of the range occupied by cow elk from May 15 to June 15. No elk production areas have been identified by the Colorado Division of Wildlife within the two coal lease tracts or the Iron Point Exploration License area (see *Figure 23, Elk Range*). The only known production area near the study area is located at higher elevations within the uppermost portions of the Terror Creek and Hubbard Creek watersheds. Only known production areas are mapped by the Colorado Division of Wildlife, and elk calving activities also are likely to occur in other areas of suitable habitat. It is likely that some level of elk calving activity occurs in lower elevation aspen habitats within the Iron Point Exploration License area especially in years with heavier accumulations of snow and delayed spring snowmelt.

The life history requirements of black bear are satisfied by a variety of habitats, including those present within the study area. Prime black bear habitat is characterized by relatively inaccessible terrain, thick understory vegetation, and abundant sources of shrub or tree borne soft or hard mast (Pelton, 1982). Black bears are omnivorous but feed primarily on herbaceous vegetation and berries. They become carnivores only when prey or carrion is readily available. Habitat areas of relative refuge from human populations are considered a prime requirement for sustaining stable black bear populations, although black bears can habituate to human presence (Pelton, 1982). Black bears are opportunistic and easily attracted by the presence of

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human food and garbage that is not properly stored. They can become a nuisance around areas of human habitation, especially in years when natural food availability is reduced. Black bears are relatively common in the study area, and Colorado Division of Wildlife WRIS mapping designates the entire area black bear overall range. Colorado Division of Wildlife WRIS mapping also indicates there is a black bear fall concentration area in the Upper Terror Creek drainage around the confluence of the East and West Fork of Terror Creek.

Mountain lion occur throughout the study area region with their range being closely tied to that of elk and mule deer. Mountain lion prey primarily on mule deer and young elk in this region and, like their prey, are typically wide-ranging. Mountain lions will follow their prey's seasonal movement and inhabit summer range or winter range in conjunction with deer and elk. They are typically shy and avoid areas with human activity. As a result of their wide-ranging habits, population densities are usually low. Documented home ranges for mountain lion in the western United States range from 32.5 to 479.0 square kilometers (Anderson, 1983). Preferred habitat of mountain lions consists of rough or steep terrain in remote areas with suitable rock or vegetational cover. Colorado Division of Wildlife WRIS mapping indicates the entire study area is classified as mountain lion overall range.

3.9.2.3 Furbearers and Predators

Due to the secretive nature and nocturnal habits of many of the furbearers, little information on distribution and population densities within the region of the study area is available. Although specific information regarding population numbers and the distribution of most of these species does not exist, some general conclusions relating to species occurrence in the study area can be made based on known habitat preferences and habitats present. Furbearers and predators present in the study area include beaver, coyote, red fox, long-tailed weasel, badger, striped skunk, and bobcat.

Bobcat and coyote occur in a wide variety of habitats, and coyotes are likely to occur wherever suitable prey (rabbits, small mammals) are present. Bobcats are found most often in association with rugged areas of rimrock, broken terrain, and rock outcrop in a variety of woodland and shrubland habitats. Preferred prey includes large rodents, rabbits, and hares, although bobcats may switch to alternative prey when preferred food items become scarce (Koehler, 1987).

The distribution of beaver in Colorado is nearly statewide where suitable aquatic habitat is present (Fitzgerald et al., 1994). Suitable aquatic habitat for beaver is restricted to primarily the perennial portions of Terror Creek and Hubbard Creek. A large beaver pond complex is present in upper Hubbard Creek near the historic (now abandoned) Blue Ribbon Mine site.

The striped skunk prefers habitats near water but can be found far from water in a wide variety of habitats. This species is most common in agricultural areas at the mid to lower elevations and is not expected to be common in the study area. Badgers and long-tailed weasels are found at all elevations within the state (Fitzgerald et al., 1994). Long-tailed weasels are found in a diversity of habitats and are likely to be present throughout the upland portions of the study area. Badgers prefer grasslands, open shrublands, meadows, and open forests where an abundance of pocket gophers and ground squirrels occur.

Red fox are found throughout Colorado. In the mountainous portions of the state they prefer montane meadows, forest edges, and riparian areas (Fitzgerald et al., 1994). These are the most likely habitats that red fox would inhabit within the study area.

3.9.2.4 Waterbirds

Waterbirds include waterfowl, shorebirds, and other wading birds typically associated with wetlands and bodies of surface water. In the study area, suitable areas of aquatic and wetland habitat for waterbirds is restricted primarily to Hubbard Creek, Terror Creek, and Terror Creek Reservoir. High elevations in combination with the general lack of shallow-water shoreline areas and emergent vegetation around water bodies, favored by many species of waterfowl and shorebirds, limits waterbird use of the study area. Use of the study area for resting, feeding, or nesting by waterbirds is limited primarily to puddle ducks (such as mallard and teal), spotted sandpiper, and killdeer.

3.9.2.5 Raptors

Several species of raptors are known to occur and nest within the region of the study area. Potential breeders include turkey vulture, northern harrier, golden eagle, Cooper's hawk, sharp-shinned hawk, red-tailed hawk, prairie falcon, American kestrel, western screech owl, great horned owl, northern pygmy owl, long-eared owl, and northern saw-whet owl.

Nest site preferences of raptors potentially breeding in the area vary considerably. Red-tailed hawks, golden eagles and great horned owls typically nest in relatively large trees with open crowns or on cliff ledges and areas of rock outcrop. Great horned owls do not build their own nests and often occupy old nests of eagles, hawks, ravens, crows, and tree squirrels in larger trees or on cliff faces. Turkey vultures nest on cliff ledges and also in hollows in snags or stumps, or in caves while prairie falcon nests on scrapes on cliff ledges or in rock cavities. All of these species prefer primarily open shrublands and meadow areas for hunting. Suitable nesting habitat for these species is provided primarily by large cottonwood trees along the lower elevation portions of the drainages or by cliffs and rock outcrop along upper portions of the canyon edges. Nesting by a pair of golden eagles has been documented by the Forest Service in Upper Hubbard Creek canyon.

The remaining potential breeding raptors in the study area are associated primarily with forested habitats except for northern harrier. Northern harriers typically nest on the ground or in low shrubs in pockets of dense shrub and grass cover typically on drainage side-slopes or near wetlands. Cooper's hawks nest in aspen or in deciduous trees in riparian situations but are also known to nest in mature conifers (Ehrlich et al., 1988; Terres, 1980). Nests are typically constructed in an upper crotch of a tree near the trunk and below the canopy top. Sharp-shinned hawks, unlike Cooper's, nest in a wide variety of wooded habitats ranging from mountain mahogany stands to conifers. Nest configuration and placement is similar to Cooper's hawk. The American kestrel is a cavity nester, and abandoned woodpecker holes, magpie nests, and crevices in rock outcrop are used as nest sites. A variety of open and wooded habitats are occupied by the American kestrel, although it avoids densely forested habitats.

Western screech owl, northern saw-whet owl, and northern pygmy owl nest in natural tree cavities or abandoned woodpecker or squirrel holes. Western screech owls are usually found in deciduous riparian habitats, while mature and old-growth mixed deciduous and coniferous forests are considered the best habitats for breeding for northern saw-whet and northern pygmy owls since the most suitable cavities for nesting are excavated by woodpeckers in large, diseased or dead trees (Reynolds et al., 1989). Northern saw-whet owls and northern pygmy owls occur over a relatively wide elevational range and have been found in low-elevation deciduous woodlands to high-elevation conifer forests (Reynolds et al., 1989). Northern saw-whet owls seem to prefer marshy or riparian areas within coniferous forests (Terres, 1980). Nests of northern pygmy owls are frequently next to meadow or marshy openings within deciduous woodlands and coniferous forests (Reynolds et al., 1989). Long-eared owl like great horned owl do not build their own nest and usually occupy abandoned magpie, hawk, crow, or squirrel nests it tall shrubs or trees (Ehrlich et al., 1988). They inhabit coniferous and mixed coniferous/deciduous woodlands. Nest sites are often at forest edges near water or moist meadow habitats (Terres, 1980). Suitable nesting habitat for all of these species, except western screech owl may be provided within the study area by stands of aspen, Douglas-fir, and spruce/fir. Lower elevation riparian habitat along the creeks represent the only potential nesting habitat for western screech owl.

3.9.2.6 Songbirds and Other Avian Species

A variety of songbird and similar species reside within the study area. The majority of these species migrate south or to lower elevations for the winter months, and only a few species remain in the region during the winter months. Woodpeckers, jays, chickadees, nuthatches, and finches are representative year-round residents. Many of the migrants are neotropical species which winter in Central and South America. Neotropical migratory birds include a full array of species that require habitats ranging from early seral or successional stages to old-growth. Others prefer edge habitat areas that occur between forested and more open habitats.

Recent reductions in Neotropical migratory bird populations have been documented in the United States by the North American Breeding Bird Survey. The causes of these reductions are not fully understood but have been attributed to a variety of factors including: reduction and fragmentation of forested breeding habitat in the United States, nest predation and parasitism, and use of pesticides and deforestation in Central and South America.

3.9.2.7 Threatened, Endangered, and Other Species of Concern

No identified critical habitat for any state or federally listed threatened or endangered species has been identified within or near the study area. *Table 3.9-1, Threatened, Endangered, and Other Species of Concern Potentially Occurring in the Study Area*, lists federal and state threatened, endangered, and other species of concern potentially occurring in the study area.

Spotted bat has been found at scattered locations (primarily in arid country) in the western United States (Barbour and Davis, 1969). Habitat occupied by this bat ranges from low desert to montane coniferous forests normally below 8,000 feet in elevation (Watkins, 1977). They have been found in a variety of habitat types including open ponderosa pine, desert scrub, pinyon-juniper, and open pasture and hay fields. They roost alone in rock crevices high up on steep cliff faces. Cracks and crevices in limestone or sandstone cliffs provide important roosting sites (Leonard and Fenton, 1983; Easterla, 1973), especially where rocky cliffs occur in proximity to riparian areas (Findley et al. 1975). Rock outcrop areas along Hubbard and Terror creeks represent the most suitable habitat areas for spotted bat within the study area.

Table 3.9-1
Threatened, Endangered, and Other Species of Concern Potentially Occurring in the Study Area

Common Name	Scientific Name	Status[1]
Mammals		
Spotted bat	*Euderma maculatum*	FS, SS
Townsend's big-eared bat	*Corynorhinus townsendii*	FS, SS
Fringed myotis	*Myotis thysanodes*	SS
Birds		
Bald eagle	*Haliaeetus leucocephalus*	T, EC
American peregrine falcon	*Falco peregrinus anatum*	E, EC
Northern goshawk	*Accipiter gentilis*	FS, SS
Flammulated owl	*Otus flammeolus*	FS
Three-toed woodpecker	*Picoides tridactylus*	FS
Black swift	*Cypseloides niger*	FS
Olive-sided flycatcher	*Contopus borealis*	FS
Southwestern willow flycatcher	*Empidonax traillii extimus*	E
Golden-crowned kinglet	*Regulus satrapa*	FS
Loggerhead shrike	*Lanius ludovicianus*	FS
Amphibians and Reptiles		
Tiger salamander	*Ambystoma tigrinum*	FS
Boreal toad	*Bufo boreas boreas*	C, FS
Northern leopard frog	*Rana pipiens*	FS

1 Status:

E = Listed Endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act. Species which are in imminent jeopardy of extinction.

T = Listed Threatened by the U.S. Fish and Wildlife Service under the Endangered Species Act. Species which are threatened with extinction.

C = Listed as Candidate by the U.S. Fish and Wildlife Service. Taxa for which the Service has sufficient information to support listing as threatened or endangered.

EC = Listed by the Colorado Division of Wildlife as endangered in Colorado. A species in immediate jeopardy of becoming extinct throughout all or a significant portion of its range.

FS = Classified as "sensitive" by the Regional Forester when occurring on lands managed by the U.S. Forest Service (5/6/94 draft listing).

SS = BLM listed species of special concern.

Townsend's big-eared bats are normally found below 9,600 feet in elevation and apparently do not prefer dense coniferous forests (Barbour and Davis, 1969). This bat is usually found in small groups (10 to 100) in mine shafts, caves, and man-made structures, often in view of light. It occurs throughout most of Colorado, but its distribution seems to be determined by suitable roost and hibernation sites (Colorado Division of Wildlife, 1984). Suitable roost and maternity sites are not present within the study area, and it is unlikely that this species is a local resident. Therefore, no further analysis will be provided for Townsend's big-eared bat in this document.

The fringed myotis occurs as scattered populations at moderate elevations on the Western Slope of Colorado and has been found in association with ponderosa pine, pinyon/juniper, and scrub oak habitats (Colorado Division of Wildlife, 1984). It apparently is not common in Colorado, and has only been found at elevations up to 7,500 feet (Fitzgerald et al., 1994.). Caves, mines, and buildings are used as day and night roosts as well as hibernation sites. Suitable roost and maternity sites are generally lacking within the study area, and it is unlikely that this species is a local resident. No further analysis will be provided for fringed myotis in this document.

Bald eagles occur primarily as wintering birds in Colorado, and wintering populations are known to occur along the major river systems in the state. A few nesting records also exist for the state. In the study area, the bald eagle is only present as a winter resident along the North Fork of the Gunnison River drainage. This drainage and adjacent habitats are designated as a winter concentration area and winter range, respectively, by the Colorado Division of Wildlife (see *Figure 24, Bald Eagle Range*). Suitable winter habitat for bald eagles consists of secure diurnal perches, winter nighttime roosts protected from severe weather conditions, and foraging areas usually associated with large lakes or rivers (U.S. Fish and Wildlife Service, 1983). Although preferred wintering areas are usually near open water where eagles feed on fish or waterfowl, bald eagles will also hunt over open, upland areas if other food sources (e.g., rabbits or deer carrion) are readily available (Green, 1985). Kirk Madariaga, District Wildlife Manager with the Colorado Division of Wildlife, indicated that as many as four to five bald eagles may be found along the North Fork of the Gunnison River near the two coal lease tracts during the winter months (Madariaga, pers. com., 1999).

The study area occurs within the nesting range of the American peregrine falcon. The peregrine's preferred nest site is a rugged, remote cliff (100 to 300 feet in height) usually overlooking water, marshy, or riparian areas where prey is abundant (U.S. Fish and Wildlife Service, 1984). Preferred hunting areas include cropland, meadows, river bottoms, marshes, and lakes which attract abundant bird life. Peregrines can travel up to 17 miles from nesting cliffs to hunting areas (U.S. Fish and Wildlife Service, 1984). There are no known peregrine falcon nest sites in the study area, and suitable nesting habitat is limited to a few cliff areas along lower Terror Creek and upper Hubbard Creek below its confluence with Willow Creek. No evidence of peregrine nesting activity was noted in these areas during the May 1999 site reconnaissance. Peregrines may occasionally wander over the study area while foraging or during migration.

The northern goshawk inhabits coniferous and mixed forests in much of the northern hemisphere. In Colorado northern goshawks nest in dense coniferous forest, often on north slopes and near water. Nesting also has been documented in aspen and in trees in riparian habitats at the lower elevations (Bailey and Niedrach, 1965). They can be found in any forested ecosystems in the Gunnison Basin area, but blocks of mature and old growth forest habitats (200 acres or greater) with a relatively open understory and small openings are preferred

(Hayward et al. ,1990; Finch, 1992; Andrews and Righter, 1992). They are sensitive to human disturbance and have abandoned nests and young due to human activities that take place too close to their nest (Kennedy and Stahlecker, 1991). Mature stands of Douglas-fir and spruce/fir, especially with adjacent stands of aspen, within the study area represent potential foraging and nesting habitat.

Flammulated owls prefer mature ponderosa pine and Douglas-fir forests with open canopies. Old growth (>200 years) or mature (>150 years) stands of ponderosa pine and ponderosa/ Douglas-fir forests, often mixed with mature aspen, are preferred as nesting habitat (McCallum, 1994). A preference for stands with an open, park-like spacing of trees may be due to this species foraging habitats (Reynolds et al., 1989). Flammulated owls are obligate cavity nesters, and they nest in natural or woodpecker cavities. Both live and dead ponderosa pine, aspen, and Douglas-fir are used for nesting (Reynolds et al., 1989). Nesting territories are relatively small; a mean size of approximately 14 ha (34.6 acres) was reported by Linkhart (1984) for a population in Colorado. Mature stands of Douglas-fir and aspen represent potential habitat for this species in the study area.

Three-toed woodpeckers are associated primarily with mixed coniferous forests up to 9,000 feet in elevation. They require snags (standing, dead trees) for feeding, perching, nesting, and roosting, although they will feed in live trees. Foraging occurs in areas with abundant dead and decayed trees where it eats mostly larvae of wood-boring beetles by peeling the bark of dead conifers to extract wood boring insects (Terres, 1980). Snags at least 12 inches dbh (diameter at breast height) and 15 feet in height are required for its excavated nest cavities (Towry, 1987). Fire or insect killed trees are major food sources. Forest fires and areas of insect outbreaks may lead to local increases in woodpecker numbers after 3 to 5 years (Bull et al., 1986; Scott et al., 1980). The general lack of diseased or burned coniferous forest stands within the study area may limit the likelihood of local populations of three-toed woodpecker.

The black swift is considered rare to uncommon in all mountain ranges in the state except the San Juan Mountains (Andrews and Righter, 1992). Foraging birds range widely at high elevations over montane and adjacent lowland habitats. They nest on precipitous cliffs near or behind high waterfalls (Andrews and Righter, 1992). Preferred nesting habitat is lacking within the study area, but foraging birds may occasionally occur over the area.

The olive-sided flycatcher is a neotropical migrant songbird that is widespread in open, mature stands of coniferous forest from the Rocky Mountains westward. In Colorado it occurs in spruce/fir forests at elevations from 9,000 to 10,000 feet (Terres, 1980). It prefers forest edges near clearings, wooded streams, and lakes and is known to use burns and clearings, including clearcuts, for foraging. This species feeds on flying insects by darting out from high, exposed perch sites. Feeding and advertising behavior is characterized by conspicuous perching near the top of dominant trees or snags in the landscape. Snags or open branches are often used as perch sites, and populations are usually highest where snags are abundant (Ehrlich et al., 1988). This species breeds primarily in mature spruce/fir and Douglas-fir habitat and is a likely summer resident in these habitats within the study area.

The southwestern willow flycatcher is also a neotropical migrant songbird that winters in Mexico and Central America and breeds as far north as the Colorado River in western Colorado. In Colorado willow flycatchers are considered an obligate riparian species that inhabit cottonwood-willow associations (Kingery and Dillon, 1987) and breed in close association with dense willow thickets (Sedgwick and Knopf, 1992). The breeding range of this subspecies includes areas of suitable habitat within the study area up to an elevation of 8,500 feet (USFWS, 1996). The only suitable areas of habitat for this species within the study area occurs in association with the large beaver pond complex on Hubbard Creek near the historic Blue Ribbon Mine. The periphery of these beaver ponds support dense stands of coyote willow (*Salix exigua*) that could support nesting activity by southwestern willow flycatcher.

Golden-crowned kinglets are considered uncommon to fairly common residents of the higher mountains in Colorado (Andrews and Righter, 1992). They breed primarily in mature, dense spruce/fir forests but can be found in all coniferous forest types and sometimes in lowland woodlands during the winter months. They seem to be most common in suitable habitats west of the Continental Divide (Andrews and Righter, 1992). Golden-crowned kinglet may inhabit mature stands of Douglas-fir and spruce within the study area.

Another neotropical migrant, the loggerhead shrike, prefers open country, thinly wooded, or scrubby land with clearings (Terres, 1980). Andrews and Righter (1992) report this species to be a fairly common resident in the western valleys of Colorado. Preferred habitats include open riparian areas, grasslands, shrublands, and open pinyon/juniper woodlands. While Robbins et al. (1989, as cited in Andrews and Righter 1992) indicate that this species has shown significant population declines over most of North America, populations appear to be stable in western Colorado (Lambeth, pers. com., as cited in Andrews and Righter, 1992). Populations are declining in the midwestern and northeastern United States for reasons which are poorly understood. Population declines may be related to the decline in agriculture and increase in second-growth forests (Fraser and Luukkonen, 1986) and the use of pesticides (Ehrlich et al., 1988). Loggerhead shrike is likely a summer resident of lower elevations shrubland habitats within the study area.

Tiger salamanders occur in virtually all habitats where there is water nearby for breeding. They are usually absent from waters where predatory fish such as trout are present (Hammerson, 1986). Shallow pools in small wetland areas, Terror Creek Reservoir, backwater areas along perennial streams, and intermittent streams within the study area represent suitable breeding habitat for this species.

The boreal toad occurs in the mountainous portions of Colorado and is most common between 8,500 and 11,000 feet in elevation (Hammerson, 1986). They hide beneath rocks or logs or in rodent burrows when inactive. Toads emerge from hibernation in May to breed and return to hibernaculum in late August and September (Hammerson,1986). Preferred breeding habitats in Colorado include wet meadows, marshes, and the margins of beaver ponds and lakes (Hammerson ,1986). Boreal toads breed in any body of water lacking a strong current and with gradually descending banks at some point around the perimeter (Loeffler, 1998). Egg placement is usually in shallows where the thermal effects of the sun are optimized (Loeffler, 1998). Available evidence indicates that females may disperse over greater distances and into drier habitats than the males (Loeffler, 1998). Recent radio re-location studies of PIT-tagged (microchiped) toads by the Colorado Division of Wildlife indicate that male toads remain within 300 meters of breeding sites, while females can move up to 3 to 4 miles from breeding areas (Jones, pers. comm., 1999). Selected upland habitats for both males and females include aspen and conifer habitats with rocky areas or ground squirrel holes where toads seek refuge in rock crevices or rodent burrows to avoid temperature extremes and desiccation (Jones, pers. comm., 1999). The boreal toad may be present in wetland areas with standing water at elevations above 8,500 feet within the study area.

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Northern leopard frogs are a highly aquatic species and are usually found in close association with the banks and shallow water areas of permanent marshes, ponds, streams, lakes, and reservoirs. Water bodies with rooted aquatic vegetation are preferred (Hammerson, 1986). Pools and slow moving streams within meadow areas represent suitable habitat for northern leopard frog in the region. Lower elevation riparian areas within the study area may provide suitable habitat for northern leopard frog.

3.9.3 Environmental Consequences

3.9.3.1 Summary

The construction of various borehole, shaft, and access road facilities would create approximately 33.5 acres of new surface disturbance in currently undisturbed areas of vegetation communities/wildlife habitats. The principal wildlife habitats to be affected would be oak and aspen habitats. Potential effects to species of concern are greatest with loss of aspen, Douglas-fir, and cottonwood habitats, but most of these potential impacts can be avoided with the implementation of appropriate mitigation measures. Impacts to sensitive wetlands and riparian habitat as well as to potential breeding habitat for boreal toad and tiger salamander would occur if there was construction of a drill site access road along Hubbard Creek to drill site IP99-7. There is a Forest Service stipulation that precludes road and pad construction in riparian areas or wetlands. Indirect impacts would include the surface effects of subsidence (mainly the creation of surface cracks), a potential increase in train and vehicle collisions with wintering mule deer and elk, and potential changes in bald eagle winter habitat resulting from flow any reductions in the North Fork of the Gunnison River.

3.9.3.2 Effects of Alternative A (No-Action).

With this alternative, the coal lease tracts would not be offered for lease, and there would be no exploration drilling within the Iron Point Exploration License area. Wildlife resources in the lease areas would essentially remain in the existing condition. As a result, wildlife habitat distribution, extent, and condition as well as wildlife populations would remain similar to existing conditions, assuming there are no major alterations in current land use activities. Wildlife habitats within the study area would continue to be subject to low levels of use in the form of recreation, grazing, logging, and other incidental activities such as firewood harvesting. There would be approximately 15 acres of new disturbance on Oxbow's fee property associated with development of the Elk Creek portal facilities. Most of this disturbance would be in oak brush habitat, but small amounts of cottonwood habitat in Elk Creek would also be lost to this development. These habitat losses would be small, next to an existing roadway, and are unlikely to have any measurable effect on existing wildlife populations. No active raptor nest sites or other sensitive habitat features would be affected by development of the Elk Creek portal facilities.

Traffic levels associated with mine personnel, train transport of coal, and truck transport of coal would remain the same, and the risk of vehicle/deer and elk collisions along State Highway 133 would remain the same. The conveyor planned to carry coal from the Bowie No. 2 portal area to the old State Highway 133 has the potential to disrupt mule deer and elk movement through winter range in this area unless properly designed underpasses are constructed at appropriate intervals along the length of the conveyor.

3.9.3.3 Direct and Indirect Effects Common to All Alternatives

An estimated 33.5 acres is proposed to be disturbed by borehole, shaft, and access road construction under all action alternatives. Disturbance to existing vegetation communities/wildlife habitats from these activities was estimated to be: 23.1 acres in oak brush, 6.4 acres in aspen, 2.7 acres in grass/forb, and 1.3 acres in cottonwood or Douglas-fir habitats.

None of these disturbances would be in elk or mule deer severe winter range and winter concentration areas or in known elk production areas, and these relatively small amounts of habitat disturbance in summer and winter range are unlikely to have any measurable effect on local elk and mule deer populations. Standard Forest Service stipulations regarding timing restrictions for surface disturbance and occupancy in elk winter range would eliminate any potential risk of indirect impacts to wintering elk from human presence. BLM also has a timing restriction as described in Unsuitability 15 in *Appendix C, Unsuitability Analysis Report - Iron Point Coal Lease Tract*, and *Appendix D, Unsuitability Analysis Report - Elk Creek Coal Lease Tract*. Minor habitat losses would also have minimal effect on wide-ranging species such as mountain lion and black bear.

With respect to threatened, endangered and other species of concern, no important or critical habitats of bald eagle and peregrine falcon would be directly affected by these surface disturbances. Southwestern willow flycatcher, boreal toad, northern leopard frog, and tiger salamander are dependent on aquatic and or wetland areas, and no surface disturbances are proposed in these areas. In addition, standard Forest Service stipulations would prohibit disturbance to these habitats including riparian areas. However, based on a field review of the proposed access road corridor to drill site IP99-7 in the Iron Point Exploration License area, it would be impossible to construct this road without impacting the riparian corridor along Hubbard Creek and also possibly wetlands along the creek bank. In many areas, the old degraded road bed is within the existing riparian corridor or is immediately adjacent to the creek bank. In addition, areas of unstable slopes have slumped across the old road bed and into the creek. Suitable habitat for southwestern willow flycatcher, boreal toad, and northern leopard frog is not present along this stretch of the creek, but potential breeding sites for tiger salamander may be present, and road building activities could adversely affect these areas.

Dust control measures, increases in potable water consumption, and potential mine-related dewatering reductions in flow to Hubbard Creek would reduce flow by 35 to 355 acre-feet per year in the North Fork of the Gunnison River and could have an effect in fisheries in this river, especially during the winter months. Reductions in winter flows could also have an effect on the extent of ice free portions of the river. These indirect impacts could alter the suitability of the North Fork Gunnison River as a winter concentration area for bald eagles.

Access roads or drill sites to be constructed in aspen, cottonwood, and Douglas-fir habitats create a potential impact risk to nest sites of forest nesting raptors such as northern goshawk, Cooper's hawk, sharp-shinned hawk, great horned owl, northern pygmy owl, long-eared owl, northern saw-whet owl, and flammulated owl. Nest sites of forested associated raptors could be impacted by direct loss or indirectly by adjacent human disturbance during the nesting season. Clearing of trees for construction could also result in the loss of snags that provide possible cavity nest sites for owls and important foraging and nesting sites for three-toed woodpecker. Snags also represent potential preferred perch sites for olive-sided flycatcher at forest edges.

There would be no disturbance of important habitats for spotted bat, Townsend's big-eared bat, and fringed myotis. Caves, old mines, and areas of rock outcrop suitable for roost, hibernation, or maternity sites for these species would not be affected by the proposed surface disturbances. There would also be no disturbance of potential nesting habitat (cliffs near waterfalls) for black swift.

There could be losses of potential habitat areas used by loggerhead shrike (oak brush) and golden-crowned kinglet (mature Douglas-fir stands), but these losses would be relatively minor. Individual birds could be affected by these losses, but minor habitat reductions would be unlikely to have any measurable effect on local populations.

The primary indirect impact that could affect local big game populations is the potential for an increase in vehicle and train killed mule deer and elk due to increased levels of employee traffic and coal transport (both train and truck) through elk and mule deer severe winter range and winter concentration areas along State Highway 133 and the North Fork of the Gunnison River. Based on conversations with Kirk Madariaga, District Wildlife Manager, Colorado Division of Wildlife (pers. comm. 1999), it could be expected that the number of vehicle and train/big game collisions would increase proportionately with the level of increase in train and passenger vehicle trips but not coal truck trips. His observations indicate that most road-killed deer and elk are killed in early winter by passenger vehicles and not by coal trucks, and the number of collisions drops off abruptly as winter progresses. He hypothesized that there were fewer collisions with coal trucks because coal truck drivers are more familiar with areas where mule deer and elk concentrate, and therefore, are better prepared to avoid collisions. According to Madariaga, approximately 5 to 10 elk and 20 to 30 mule deer are killed per year along Highway 133 in the general vicinity of the two mine operations. He also indicated that coal trains kill mule deer and elk, and in possibly higher numbers than those killed along the highway, since wintering elk and deer tend to concentrate more in areas along the railroad right-of-way. However, he had no personal documentation to substantiate the number of train/big game collisions.

3.9.3.4 Effects of Alternative B

Direct impacts to wildlife habitats would be consistent for all alternatives. The only potential indirect impact that could vary with the different alternatives is subsidence. As noted in Section 3.4, Soils, the effect of subsidence would manifest itself as cracks forming on the earth's surface followed by a settling of the ground elevation as the geologic strata cave, at depth, behind the advancing long-wall operation. Some cracks, devoid of vegetation, would remain on the surface at the conclusion of mining. The extent of wildlife habitat which would be affected by cracking cannot be calculated but would likely be minimal considering the potential acreage involved and the natural ability of these cracks erode, seal, and eventually revegetate. It is unlikely that a measurable acreage of wildlife habitat would be lost given these considerations.

Subsidence also has the potential to disrupt springs or other sources of surface water, thereby affecting important wetland and riparian habitats as well as watering areas for wildlife. However, if there is disruption of surface water sources, Forest Service standard stipulations would require the mine operator to replace this loss with water from an alternate source in sufficient quantity to maintain existing riparian habitat and wildlife use. Therefore, there should be no long-term adverse impacts to wildlife or wildlife habitat from disruption of surface water sources.

3.9.3.5 Effects of Alternative C

The effects of this alternative would be similar to Alternative B except for the indirect effects of subsidence. The effects of subsidence under Alternative C would be greater than under Alternative B given the adoption of multi-seam mining activities and the larger lease acreage involved. With multi-seam mining, the depth to which geologic strata cave behind the advancing mining operation would be greater. Given that the lease area under Alternative C is approximately 10 percent greater than under Alternative B, a comparatively larger acreage would be subject to the effects of subsidence.

3.9.3.6 Effects of Alternative D

Alternative D is identical to Alternative C except that subsidence would not be permitted under specific features such as Terror Creek, Hubbard Creek, or the Curecanti-Rifle 230/345 kV electric transmission line. Effects on riparian habitat in Terror and Hubbard Creeks would not occur. As a result, the effects on existing wildlife habitats and populations would be the same only over a slightly smaller lease area. There would also be less risk of disruption of surface water sources and associated riparian habitats and wildlife watering areas.

3.9.4 Cumulative Impacts

Approximately 33.5 acres of wildlife habitat would be affected by surface disturbances on the lease and exploration areas. Seventy acres of previous disturbances are associated with the existing Bowie No. 2 Mine and approximately 95 acres have been disturbed at Oxbow's Sanborn Creek Mine. Approximately 10 to 15 acres and 15 acres of additional disturbances are planned at these two mining operations, respectively. The acreage of wildlife habitat that would be directly affected within the cumulative effects area by any action alternative represents a relatively minor short-term increase in lost habitat. The acreage of wildlife habitat affected by subsidence would not measurably increase habitat loss.

Human population increases in the region due to expanded and continued mining, as well as to expected general population increases unrelated to mining, would create increases in human recreational activities, including hunting. Increased recreational use of public lands would place additional human disturbance pressures on wildlife populations as well as increase hunting pressure on big game populations. The magnitude of these effects on regional wildlife populations is impossible to predict.

3.9.5 Possible Mitigation and Monitoring

Aside from standard Forest Service stipulations imposed to protect wildlife and wildlife habitat and BLM unsuitability criteria, only two additional mitigation measures are proposed to protect habitat for wildlife species of concern. For any construction activities in forested habitats of aspen, Douglas-fir, and cottonwood, these areas should be surveyed for evidence of raptor nesting activity prior to construction. If any nest sites are located, the timing and/or the location of construction should be modified to preclude any impacts to raptor nest sites. This mitigation would be effective in minimizing or preventing impacts to breeding pairs of raptors and their fledglings.

Since snags, and especially large snags, provide potential nest sites for cavity nesting owls, foraging and nest sites for three-toed woodpecker, and perch sites for olive-sided flycatcher, all proposed development sites in forested habitats should be surveyed for the presence of snags. If any snags are located, the locations of surface disturbance should be modified to the extent necessary to avoid the loss of snags. This mitigation would be effective in protecting potential nest sites for previously-mentioned species.

3.10 AQUATIC RESOURCES/FISHERIES

***Issue:** Minimize disturbance to fish habitat and fish populations. Areas of concern include: direct disturbance of stream channels; reduced flow; stream sedimentation; water quality degradation; and impacts to threatened and endangered aquatic species.*

3.10.1 Introduction

Fisheries and aquatic habitat information are discussed for streams, reservoirs, and ditches that are located within and surrounding the Iron Point and Elk Creek Coal Lease Tracts and the Iron Point Exploration License area. Information was obtained by reviewing available literature and conducting a field reconnaissance on May 17 and 18, 1999. Water bodies that are located within or immediately adjacent to the study areas include Elk Creek, Bear Creek, Hubbard Creek, Alder Creek, Terror Creek, West Fork Terror Creek, Terror Creek Reservoir, and several irrigation ditches. Three of the streams (Hubbard, Terror, and West Fork Terror Creeks) are perennial streams that contain flows throughout the year. These streams support trout species and special concern fish species. Elk, Bear, and Alder Creeks are intermittent streams that do not contain year-round habitat for aquatic species.

Fisheries and aquatic information also is discussed for the North Fork of the Gunnison River and the Gunnison River. These streams contain important game fish species and federally endangered and special concern fish species.

3.10.2 Affected Environment

3.10.2.1 North Fork of the Gunnison River

The mainstem section of the North Fork Gunnison of the River is classified as Class I Cold Water Aquatic Life by the Colorado Department of Public Health and Environment. This classification is defined as " . . . waters that (1) currently are capable of sustaining a wide variety of cold water biota, including sensitive species, or (2) could sustain such biota but for correctable water quality conditions" (CDPH, 1999). Game fish species present in the river include rainbow trout, brown trout, cutthroat trout, and brook trout (Hebein, 1999). Rainbow, brown, and cutthroat trout were stocked in the river from 1973 through 1995. Based on surveys conducted by the Colorado Division of Wildlife, low to average numbers of trout were collected. Rainbow trout and brown trout usually represent the most abundant game fish species. Other game fish species such as northern pike and green sunfish sporadically occur in low numbers (Hebein, 1999). These species likely originate from Paonia Reservoir. Native species collected in the river consisted of roundtail chub, bluehead sucker, flannelmouth sucker, speckled dace, longnose dace, and mottled sculpin (see *Table 3.10-1, Fish Species Occurrence Within the Project Study Area Streams*).

Adequate habitat and water quality conditions are available in the North Fork of the Gunnison River to support trout populations. The general types of habitat present in the river below Hubbard and Terror creeks include a mixture of long runs and smaller riffles and pools. In

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TABLE 3.10-1
Fish Species Occurrence Within the Project Study Area Streams

Common Name	Scientific Name	Status[1]	North Fork Gunnison River	Hubbard Creek	Terror Creek	West Fork & East Fork Terror Creek	Gunnison River
Trout	***Salmonidae***						
Cutthroat trout	*Oncorhynchus clarki*	G	X	X	X	X	
Rainbow trout	*Oncorhynchus mykiss*	G	X	X			X
Brown trout	*Salmo trutta*	G	X	X			X
Brook trout	*Salvelinus fontinalis*	G	X	X		P[3]	
Pike	***Esocidae***						X
Northern pike	*Esoc lucius*	G	X				
Carp/Minnows	***Cyprinidae***						
Humpback chub	*Gila cypha*	FE, SE					X
Bonytail[4]	*Gila elegans*	FE, SE					
Roundtail chub	*Gila robusta*	SSC; BLM SC	X	P[3]			
Red shiner	*Cyprinella lutrensis*	NG					X
Carp	*Cyprinus carpio*	NG					X
Sand shiner	*Notropis stramineus*	NG					X
Flathead minnow	*Pimephales promelas*	NG					X
Colorado pikeminnow	*Ptychocheilus lucius*	FE, SE					X
Longnose dace	*Rhinichthys cataractae*	NNG	X				
Razorback sucker	*Rhinichthys osculus*	NNG	X	X	X	X	X
Suckers	***Catostomidae***						
White sucker	*Catostomus commersoni*	NG	X	X			X
Bluehead sucker	*Catostomus discobolus*	SSC; BLM SC	X	X			X
Flannelmouth sucker	*Catostomus latipinnis*	SSC; BLM SC	X				X
Razorback sucker	*Xyrauchen texanus*	FE, SE					X
Catfishes	***Centrarchidae***						
Black bullhead	*Ameirius melas*	G					X
Channel catfish	*Ictalurus punctatus*	G					X
Sunfishes	***Centrarchidae***						
Green sunfish	*Lepomis cyanellus*	G	X				X
Smallmouth bass	*Micropterus dolomieui*	G					X
Largemouth bass	*Micropterus salmoides*	G					X
Sculpins	***Cottidae***						
Mottled sculpin	*Cottus bairdi*	NNG	X	X	P[3]		X

[1] Status: G = game fish; NG = introduced nongame; NNG = native nongame; FE = federally endangered; SE = Colorado endangered; SSC = Colorado special concern; and BLM SC = BLM special concern.
[2] These are the most abundant species; refer to Burdick (1995) for a list of other species in the river.
[3] P = Potential occurrence based on habitat.
[4] Bonytail does not occur in the Gunnison River, but it is present (rare) in the Colorado River.

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wider sections of the river, the channel is braided with islands and side-channels. Fish cover is provided mainly by instream substrate and other structures. Factors that limit the quality of aquatic habitat include low summer flows due to irrigation diversions, return irrigation flows, siltation, general lack of cover, and livestock disturbance (Hebein, 1999).

3.10.2.2 Tributaries

The following information summarizes aquatic habitat and fisheries in project area tributaries. Two drainages, Hubbard and Terror Creek, both support trout populations. Three intermittent streams (Elk, Bear, and Alder creeks) do not contain game fish species or threatened, endangered, or special concern species. Trout and native fish species occur seasonally in Terror Creek Reservoir and the irrigation ditches (Terror Creek and Overland). However, drawdown in Terror Creek Reservoir in the summer restricts year-round habitat for fish. Based on discussions with the Colorado Division of Wildlife and the Forest Service, no macroinvertebrate surveys have been conducted in the tributaries.

Habitat conditions in Hubbard Creek are largely determined by gradient and channel configuration. In the lower two miles (i.e., above the North Fork of the Gunnison River confluence), the stream flows through canyon areas with moderately steep gradient. Riffles and runs represent the dominant types of habitat along with small side-pools. Boulders and cobbles are the predominant substrates. Fish cover is provided by instream substrate and organic debris (logs, tree limbs) and overhanging riparian vegetation. At an elevation of approximately 6,200 feet, the stream is characterized by lower gradient and a wider, meandering channel. A series of beaver ponds are located about 2,000 feet downstream of the historic (now abandoned) Blue Ribbon Mine area. Above the beaver ponds, the channel contains a more diverse mixture of pools, riffles, and runs. Higher quality habitat for fish is present in the form of undercut banks, instream substrate, and overhanging willows. Colorado Division of Wildlife indicated that stream reaches below 9,800 feet and gradients less than 3 percent are the most productive trout habitat (Forest Service, 1986).

Habitat conditions at most of the proposed exploration drill sites mainly reflect a steeper gradient stream, as shown in *3.10-2, Summary of Aquatic Habitat Conditions at Proposed Exploration Drill Sites Near Hubbard Creek*. Drill Site IP99-22, which is located in the upper portion of Hubbard Creek, was not accessible. However, gradient in this area was less than IP99-23 through IP99-27. Some factors that limit aquatic habitat in Hubbard Creek include erosion, excessive siltation, and water diversion for irrigation.

Two instream flow recommendations were appropriated for Hubbard Creek in 1984 by the Colorado Water Conservation Board: 4 cubic feet per second (cfs) in an 6.1-mile segment in the headwaters and 3 cfs in a 2.5-mile segment in T2S, R91W, Sections 14, 23, 26, and 35. The purpose of the recommendations was "to preserve the natural environment to a reasonable degree" (Colorado Water Conservation Board, 1984).

Hubbard Creek provides habitat for trout and native fish species. Trout species present in the stream include rainbow, brown, brook, and cutthroat (Wang, 1998; Colorado Division of Wildlife, 1978). The Colorado Division of Wildlife stocked several varieties of cutthroat trout and rainbow trout between 1973 and 1996. Although Colorado River cutthroat trout were included in some of these stocking efforts, interbreeding with other cutthroat varieties has resulted in no pure

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Table 3.10-2
Summary of Aquatic Habitat Conditions at Proposed Exploration Drill Sites Near Hubbard Creek

Drill Site Numbers	Gradient	General Type of Habitat	Fish Cover
IP99-23 - IP99-27	Moderately steep	Riffles and runs with small side pools; boulders and cobbles	Instream substrate, overhanging willows
IP99-7	Low gradient	Long pool with silt-dominated substrate	Depth
Downstream of IP99-7	Moderately steep	Riffles and runs with moderately large side pools; boulders and cobbles	Instream substrate, overhanging willows instream debris (logs)

strains being present. Other fish species inhabiting Hubbard Creek include bluehead sucker, speckled dace, white sucker, and mottled sculpin (BLM, 1998; Colorado Division of Wildlife, 1978). West Fork Hubbard Creek contains the same trout and native fish species.

The Terror Creek drainage (East Fork Terror, West Fork Terror, and Terror creeks) is characterized as moderately steep with gradients ranging from approximately 5 to13 percent. Within the project study area, elevations vary from approximately 6,700 to 7,800 feet. Stream widths vary from 5 to 20 feet with boulder-dominated substrates in most segments. Cobbles and gravel substrates are also present. Cascading riffles, short runs, and relatively small pools are the types of general habitat. Fish cover is provided by overhanging riparian vegetation, instream substrates, and organic debris. The Colorado Division of Wildlife rated fish habitat in East Fork Terror Creek as poor and West Fork Terror Creek as average. Limiting factors for fisheries in the drainage include siltation, erosive soils, and lack of water during the summer through winter period (Colorado Division of Wildlife, 1978).

Based on limited sampling in West Fork Terror and East Fork Terror creeks, fish species in the drainage consist of cutthroat trout and speckled dace. The lower portion of Terror Creek near the confluence with the North Fork of the Gunnison River may also support species such as longnose dace, mottled sculpin, flannelmouth sucker, and bluehead sucker. Cutthroat trout were stocked in Terror Creek in 1982 and 1988 through 1996. The upper portions of the drainage also may contain brook trout, as this species was observed in Terror Creek Reservoir (Rudin, 1999).

3.10.2.3 Gunnison River

The 75-mile section of the Gunnison River between its confluences with the North Fork of the Gunnison River and Colorado River is classified by the Colorado Department of Public Health and Environment (1999) as Class I Cold Water Aquatic Life. However, recent fish surveys in the Gunnison River indicated a cold water fishery in the upper portion of this segment and a warm water fishery in the lower portion (Burdick, 1995). After constructing the Aspinall Unit, the transition zone from cold water fish species to warm water species was determined to be between the confluence with the North Fork of the Gunnison River, River Mile (RM) 75 and Drysdale Flats (RM 67). The warm water fishery was dominated by native fish species. In 1992 and 1993, approximately 79 percent of the total catch was comprised of native species, largely due to bluehead sucker, flannelmouth sucker, and roundtail chub (Burdick, 1995). Carp and white sucker were the most frequently encountered non-native species by comprising 7

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and 6 percent of the total catch, respectively. Numerous minnow species such as red shiner, sand shiner, fathead minnow, and speckled dace also were collected in seining surveys. Rainbow trout and brown trout, which individually comprised approximately 2 to 3 percent of the total catch, were the most abundant game fish species. The highest trout numbers were collected between RM 60 and 75. Other game fish species that individually comprised less than 1 percent of the total catch included northern pike, black bullhead, channel catfish, green sunfish, largemouth bass, and smallmouth bass.

Relatively diverse aquatic habitat conditions are found in the Gunnison River between the North Fork of the Gunnison River and Colorado River confluences. From the North Fork confluence (RM 75) to Drysdale Flats (RM 67), the river flows through a wide canyon. An extensive floodplain occurs from RM 67 downstream to Roubideau Creek (RM 50), which contain a variety of habitats such as braided channels, vegetated islands, long runs, riffles, and backwaters (Burdick, 1995). From RM 50 to Whitewater (RM 15), the river flows through narrow canyon areas. A mixture of moderate velocity riffles, quiet shorelines, and slow runs are found between Whitewater and the Redlands Diversion Dam (RM 3). A canyon area exists just above the Redlands Diversion Dam. Restoration activities in the Gunnison River have involved the construction of the fish passageway at the Redlands Diversion Dam, flow recommendations, and restoration of wetland habitats adjacent to the river (Burdick, 1995).

3.10.2.4 Threatened, Endangered, and Sensitive Species

Four federally endangered fish species occur in river segments located downstream of the coal lease tracts: Colorado pikaminnow (squawfish), razorback sucker, humpback chub, and bonytail. Colorado pikeminnow and razorback sucker presently occur in the Gunnison River. Three special concern species (Colorado and BLM) also are present in downstream areas: bluehead sucker, flannelmouth sucker, and roundtail chub. Although Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*), (Forest Service sensitive and Colorado special concern species) were previously stocked in Hubbard and Terror Creeks, the populations are not considered pure strains (see Section 3.10.2.2, Tributaries). The following information summarizes the distribution, critical habitat designations, habitat use, and spawning periods for these species except Colorado River cutthroat trout.

Colorado Pikeminnow - Downstream river segments inhabited by Colorado pikeminnow include the Gunnison and Colorado rivers. In the Gunnison River, the present distribution includes the lower 30 to 40 miles. The upper distribution is between Bridgeport at RM 30 and the Escalante Bridge (RM 41.9) (Burdick, 1999). Between 1918 and the spring of 1996, this species was limited to the lower 3 miles of the Gunnison River because of the Redlands Diversion Dam (RM 3). In June 1996, a fish ladder was constructed at the Redlands Diversion Dam, which allowed fish to move upstream of the dam. This species also is found in the mainstem portion of the Colorado River near Palisade, Colorado downstream to Lake Powell (USFWS, 1994). Six critical habitat reaches have been designated for this species in the Colorado River drainage (USFWS, 1994). Two reaches are located downstream of the coal lease tracts: (1) Gunnison River and its 100-year floodplain from its confluences with the Uncompahgre and Colorado Rivers; and (2) Colorado River and its 100-year floodplain from the Colorado Bridge at exit 90 north of Interstate 70 (RM 238) downstream to the Dirty Devil arm of Lake Powell.

Habitat requirements of Colorado pikeminnow depend upon the life stage and time of year. Young-of-the-year (YOY) and juveniles prefer shallow backwaters, while adults prefer pools, eddies, and deep runs (Miller et al., 1982). Adults seem to prefer depths of about 2 to 7 feet, velocities of 0 to 0.2 feet per second, and boulder/silt substrates (Valdez et al., 1982). Juveniles and YOY are usually found over silt or sand bottoms with minimal current (Tyus et al., 1982). During peak runoff in the spring and early summer, fish usually move into backwater areas of flooded riparian zones to avoid swift velocities, feed, and prepare for the upcoming spawning period (Valdez and Wick, 1983). As adults mature, they become highly mobile during the spawning period, which occurs after peak runoff from mid-June to mid-August. Larvae drift downstream from spawning sites beginning in late June and continue until late August.

Razorback Sucker - The Gunnison and Colorado rivers represent the closest downstream rivers inhabited by razorback sucker. In the Gunnison River, wild razorback sucker are thought to be extirpated (Burdick and Bonar, 1997). As a result, approximately 4,938 juvenile and sub-adults have been stocked between October 1995 and October 1998 (Pfeifer and Burdick, 1998). The stocking program has extended the distribution in the Gunnison River from the Hartland Diversion Dam at RM 60 downstream to the confluence with the Colorado River. Razorback sucker also are found at scattered locations in the Colorado River. Critical habitat has been designated for 15 reaches in the Colorado River Basin. The closest downstream reaches in relation to the coal lease tracts include (1) Gunnison River and its 100-year floodplain from its confluences with the Uncompahgre River to the Redlands Diversion Dam; and (2) Colorado River and its 100-year floodplain from the Colorado Bridge at exit 90 north of Interstate 70 (RM 238) downstream to Westwater Canyon (USFWS, 1994).

Habitat requirements for razorback sucker reflect both riverine and reservoir environments. General habitats used by adults include eddies, pools, and backwaters during the non-breeding period (July through March) (Maddux et al., 1993). Osmundson and Kaeding (1991) summarized seasonal habitat use as follows: pools and eddies from November through April, runs and pools from July through October, runs and backwaters in May, and backwaters and flooded gravel pits during June. Juveniles seem to prefer shallow water and minimal flow in backwaters, tributary mouths, off-channel impoundments, and lateral canals (Maddux et al., 1993). The spawning period for razorback suckers in the Upper Colorado River Basin usually occurs in April through mid-June. However, limited spawning has been documented for this species in the Upper Colorado River basin.

Humpback Chub - The occurrence of humpback chub is limited to one known recent record in the Gunnison River and river canyon sections in the Colorado River. One humpback chub was captured in a canyon-reach of the Gunnison River in 1993 (Burdick, 1995). In the Upper Colorado River, this species is found in the Black Rocks and Westwater Canyon reaches near the Colorado-Utah state line, Professor Valley near Moab, and Cataract Canyon near Lake Powell (Maddux et al., 1993). Seven critical habitat designations exist within the Colorado River Basin. Of these reaches, two are located downstream of the Bowie and Oxbow mines in the Upper Colorado River: (1) Black Rocks to Fish Ford River; and (2) Brown Betty Rapid to Imperial Canyon just upstream of Lake Powell (USFWS, 1994).

Humpback chub are mainly found in river canyons, where they utilize a variety of habitats. In general, they prefer deep pools (about 25 to 65 feet deep), eddies, and upwells near boulders, steep dropoff cliff faces, and sand/gravel bars near boulders (Maddux et al., 1993). YOY chubs usually are found in backwaters and quiet pockets of water on rock benches or along steep rock walls (Valdez and Clemmer, 1982). Juveniles occur in backwaters, eddies, and runs, with low velocities and sand, silt, or boulder substrates (Valdez et al., 1982). Spawning occurs in May

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through July after the peak spring flows at water temperatures ranging from about 50° to 68° F (Maddux et al., 1993).

Bonytail - The bonytail is considered to be the rarest of the four Colorado River federally endangered fish species. Since intensive sampling began in 1977, only a few individuals have been collected in the Upper Colorado River Basin. In the mainstem portion of the Upper Colorado River, one to five individuals were collected in the Black Rocks area, Cataract Canyon about 20 miles upstream of Lake Powell, and Lake Powell (Kaeding et al., 1986; Maddux et al., 1993). No bonytail have been collected in the Gunnison River.

The general types of habitat used by bonytail include mainstem river and impoundments on the Colorado River. Collection sites for this species in the Upper Colorado River Basin were characterized as deep pools and eddies with slow or fast currents (Kaeding et al., 1986). Substrates at the collection sites consisted of silt, silt-boulder, and boulders (Vanicek and Kramer, 1969). Limited information is available concerning spawning requirements for this species. It is assumed that spawning occurs in June or July, based on studies in the Green River.

Flannelmouth Sucker and Bluehead Sucker - These native suckers occur in the North Fork Gunnison, Gunnison, and Colorado Rivers. Both species are found in a variety of habitats that include riffles, pools, runs, and backwater areas in larger streams and rivers (Sublette et al., 1990). In most instances, the streams have minimal vegetation, moderate to high turbidities, and high spring flows. Depths usually range from 1 to 6 feet, with substrates consisting of rocks, gravel, or mud (Sigler and Miller, 1963). Spawning occurs in the spring or early summer at lower elevations and in summer at higher elevations.

Roundtail Chub - This species also occurs in the North Fork of the Gunnison River, Gunnison, and Colorado Rivers. Roundtail chub inhabits pools, eddies, runs, and riffles in moderate to large rivers (Karp and Tyus, 1990; Sublette et al., 1990). Adults prefer pools associated with undercut banks and other types of cover, while young fish occur in shallower water with lower flows. All age groups prefer cobble-rubble, sand-cobble, or sand-gravel substrates (Sublette et al., 1990). Runs and riffles are used primarily during feeding periods. Spawning occurs in the spring and early summer when water temperatures are approximately 68° F (Sublette et al., 1990).

3.10.3 Environmental Consequences

3.10.3.1 Summary

Short-term, local increases in turbidity and suspended sediments could occur during exploration activities adjacent to Hubbard Creek and Terror Creek, and if access roads are constructed for mining both the Iron Point and Elk Creek Coal Lease Tracts. These short-term increases in sediment yield could result in short-term effects on aquatic species and their habitat. Sediment concentrations would stabilize and return to typical background concentrations after the construction activities are completed. By implementing proper drainage and detention structures, the impact of increased sediment levels on aquatic species and their habitat would be low. Any localized increases in sediment would not affect downstream areas in the Gunnison and Colorado rivers that are inhabited by four federally endangered fish species.

The use of water for mining activities, dust control, and domestic purposes would result in a relatively small depletion of water from Terror Creek, Hubbard Creek, and the North Fork of the Gunnison River. Water would be provided from existing sources. The estimated withdrawal of water would result in total reductions less than 1 cfs. This small depletion would represent a relatively small reduction in habitat for fish and benthic macroinvertebrate species. This depletion would be even smaller in the sections of the Gunnison and Colorado rivers that are inhabited by four federally endangered fish species.

Mine dewatering also could result in reduced flows in the middle and lower portions of Hubbard Creek (near and downstream of the historic Blue Ribbon Mine). The estimated volume of water removed from the Hubbard Creek drainage due to underground mining could range from approximately 35 to 355 acre-feet per year, with an average of 195 acre-feet per year. These volumes would represent approximately 0.1 to 14 percent reductions in the base flow conditions in Hubbard Creek. Impacts associated with this depletion would be reduced habitat for fish and macroinvertebrate communities in Hubbard Creek. A relatively small depletion also would occur in the North Fork of the Gunnison and Gunnison rivers. Special concern fish species are present in both rivers, while two federally endangered fish species occur in the Gunnison River.

Actual water depletion estimates would be made during the mine permitting and mining plan decision processes with Colorado DMG and OSM. Final consultation with the U.S. Fish and Wildlife Service would occur at that time.

Mining operations for both coal leases would result in increased discharges to the North Fork of the Gunnison River. However, since all discharges must meet federal and Colorado Department of Public Health and Environment regulations, no adverse effects on aquatic species are anticipated due to the quality of the discharge water.

The use and transport of fuels to the exploration sites and mining operations would represent a risk to aquatic species and their habitat, if a spill or accident occurred. By implementing a mitigation measure that would restrict the use of fuels near streams, water bodies and their associated biological communities would be protected. The risk of a fuel spill or leak reaching the North Fork of the Gunnison River, Hubbard Creek, or Terror Creek during transport is considered extremely low, based on the expected low frequency of traffic.

Cumulative impacts may occur in the study area due to other coal exploration and mining activities, highway upgrade construction, agriculture, and logging. Potential cumulative impacts would consist of short-term, localized increases in sediment and additional water depletions (primarily related to agricultural operations). The extent of the sedimentation impacts would depend upon the effectiveness of the sediment control practices, presence of drainages near the construction area, and distance to perennial streams.

3.11.3.2 Effects of Alternative A (No-Action)

Under the No-Action Alternative, present mining operations would continue for the existing Bowie and Oxbow properties. Short-term, local increases in turbidity and suspended sediments would occur in the vicinity of new surface disturbance areas, which include a new conveyor belt and coal storage loadout area for the Bowie No. 2 Mine and construction of the Elk Creek portal on private land for the Oxbow property. The closest drainages in relation to the new disturbance areas include Elk Creek for the Oxbow property and the North Fork of the Gunnison River for the Bowie No. 2 property. The North Fork of the Gunnison River contains both game and non-game fish species, while the intermittent Elk Creek does not support a fishery. By implementing required erosion and sediment control measures, the potential effects of any increases in sedimentation would be considered minor. Any localized increases in sediment would not affect water quality in the Gunnison River, which is inhabited by two federally endangered fish species, Colorado pikeminnow and razorback sucker.

The continued operations of both properties would require water for domestic use, and underground and surface dust control. The total estimated water use for each mine operation would be an average of 65 to 66 acre-feet per year for the Bowie property and 156 to 197 acre-feet per year for the Oxbow property. A portion of the Oxbow use is discharged to the North Fork of the Gunnison River under an existing NPDES permit. These volumes represent a total of less than 0.5 cfs for both the Bowie and Oxbow operations. Existing water sources would be used.

Mine water would continue to be discharged for both operations at the present levels. No additional sedimentation ponds or new discharge points would be required. By meeting the required NPDES water quality standards, no adverse impacts to water quality or aquatic species and their habitat would occur, as a result of the No-Action Alternative.

3.10.3.3 Effects Common to All Action Alternatives

Direct Effects - The potential effects of the action alternatives on aquatic resources are closely related to impacts on surface water and groundwater resources, which are discussed in Section 3.5.3, Surface Water, and Section 3.6.3, Groundwater. Direct impacts to aquatic resources could result from four factors: changes in water quality, water withdrawals, mine dewatering, and physical habitat disturbance. The following information describes potential impacts on aquatic resources that are common to all action alternatives. Differences in potential effects on aquatic resources are discussed separately for each alternative.

Water would be used for exploration, underground and surface dust control, and domestic purposes for all alternatives. The estimated range in total annual volumes of water for these uses include 3 to 6 acre-feet per year for exploration, 293 to 337 acre-feet per year for dust control, and 12 to 14 acre-feet per year for domestic purposes. The dust control and domestic water uses represent the total for mining operations conducted on both the Iron Point and Elk Creek Coal Lease Tracts. These water uses would be the same as discussed under the No-Action Alternative. The overall total volume would represent approximately less than 0.5 cfs. These slight reductions in flow would result in a relatively small reduction in wetted habitat for fish and benthic macroinvertebrates in Terror and Hubbard creeks. The small magnitude of flow reduction would not be expected to affect spawning or rearing habitat for trout species in these creeks. An even smaller reduction in habitat would occur in the North Fork of the Gunnison River, which is inhabited by trout. Potential impacts on threatened, endangered, or special concern species are discussed at the end of this subsection.

Mine dewatering for the Iron Point Coal Lease Tract also would result in reduced flows in the middle and lower portions of Hubbard Creek (near and downstream of the historic Blue Ribbon Mine), as discussed in Section 3.6.3, Groundwater. The estimated volume of water removed from the underground mine area would be an average of 195 acre-feet per year. This volume could result in flow reductions of approximately less than 1 cfs in Hubbard Creek. Impacts associated with this depletion would be reduced habitat for fish and macroinvertebrate communities.

In relation to the instream flow recommendations that were appropriated for Hubbard Creek by the Colorado Water Conservation Board (i.e., 4 cfs in a 8.1-mile segment in the headwaters and 3 cfs in a 2.5-mile segment in T12S, R91W, Sections 14, 23, 26, and 35), water use for exploration could contribute an extremely small depletion (less than 0.05 cfs per week) to periods when baseline flows could be less than 3 cfs at the Lower Hubbard Creek segment. This would be a short-term impact that could occur for several months during two years. Sections of Hubbard Creek potentially affected by mine dewatering are located downstream of the 2.5-mile segment with a minimum instream flow recommendation.

Potential water quality impacts from sedimentation and fuel or chemical spills could adversely affect aquatic resources. The impacts of fuels and other chemical spills depend on the volume spilled, proximity to the stream, time of year, flow conditions, physical characteristics of the streams; and the response and effectiveness of the cleanup and control techniques. The types of chemicals transported to the mine sites or stored at the sites include gasoline, diesel fuel, and small amounts of solvents and other miscellaneous chemicals. It is assumed that fuel would be transported by local suppliers, which would involve a transportation route along State Highways 92 and 133. Both highways are parallel to and cross the North Fork of the Gunnison River, although State Highway 133 is considerably closer to the river.

Petroleum products exhibit both acute lethal toxicity (short-term) and long-term sublethal chronic effects on aquatic organisms. If a spill or leak entered a water body (Hubbard Creek, Terror Creek, or North Fork of the Gunnison River), aquatic organisms could be exposed to lethal conditions. Because the aromatic (most toxic) components of gasoline and diesel fuel would volatilize rapidly after being released, the period of exposure would be relatively short (Edgerton et al., 1987; Markarian et al., 1994). Previous biological studies conducted after gasoline and diesel fuel spills have shown that toxic conditions existed for periods ranging from several hours to several weeks, depending upon the factors listed above (Bury, 1972; Pontasch and Brusven, 1988; ENSR, 1989; and Green and Trett, 1989). As a result of the low persistence of gasoline and diesel fuel and high reproductive rates, macroinvertebrate communities typically recover within about 6 to 12 months. The recovery period for fish ranges from less than one year to about two years, depending upon impacts to early life stages (Green and Trett, 1989). A spill or leak during the spring or fall spawning and fry development periods for trout could potentially result in more severe impacts that could take several years for recovery.

Potential effects of solvent or other chemical spills or leaks would not likely affect surface water and aquatic communities. These chemicals would be stored in areas located outside of any intermittent or perennial drainages. Although localized spills or leaks may occur, cleanup and containment would eliminate the risk of these chemicals entering surface waters that contain fish and invertebrate communities.

In general, disturbance to aquatic habitat from construction of exhaust shafts, degasification boreholes, ventilation shaft, and access roads would be minor. In most instances, these construction areas are not located within intermittent or perennial drainages. One road crossing may be required on Bear Creek, an intermittent stream, which could result in short-term, temporary increases in sediment. Sediment increases in a localized area downstream of the crossing may cover substrates and reduce macroinvertebrate production. No game fish species occur in this stream. By implementing proper drainage and sediment control measures and timing the construction during a low flow period, the effects on macroinvertebrates would be considered minor.

Exploration activities would require construction of approximately 2 miles of new access roads and drilling operations at 26 boreholes. Vehicle traffic along existing roads adjacent to Terror and Hubbard Creeks could result in relatively small magnitude, short-term increases in sediment, as air-borne particles and surface soil are deposited in streams. The expected small relative increase in sediment levels from vehicle traffic would not likely affect macroinvertebrate and fish productivity. Although not anticipated, construction of a new road along Hubbard Creek to access drill hole IP99-7 would result in increased sediment to Hubbard Creek. This 1.5 mile section of Hubbard Creek exhibits considerable slumping and erosion on the west side of the channel. Disturbance to the area adjacent to the creek could result in relatively large sediment increases that could affect macroinvertebrate and fish communities. Sediment could cover substrates used by macroinvertebrates and alter habitat used by trout for spawning and fry development. The accumulation of fine sediments adversely affects biotic communities by physically covering animals, reducing oxygen availability, reducing food, and eliminating spawning areas (Waters, 1995).

Exploration activities also may require the construction of a sump pit for drilling fluids at each of the drill hole sites; however, most exploration would be conducted using a closed system. Spills or leaks from the sump pit could contribute sediment to the stream. Fluids in the sump pits consist of drilling muds and bentonite material. The effects of drilling muds on aquatic communities would be similar to sedimentation impacts. By adhering to proper design of the sump pits, spills or leaks of reserve pit fluids to adjacent streams would be minimized. If a spill or leak occurred, cleanup and containment procedures would be required to reduce impacts to surface water and aquatic communities and their habitat. After completing the exploration activities, each site would be reclaimed. The sump pits would be regraded and disturbed soil would be recontoured and revegetated.

Mining operations associated with all action alternatives also would require increased discharges to sedimentation ponds and the North Fork of the Gunnison River. Under each alternative, discharges would need to meet NPDES requirements. Periodic monitoring of mine effluents would ensure that effluents were not adversely affecting water quality or causing potential toxic effects on aquatic organisms. If concerns were identified during monitoring, corrective actions would be implemented to make sure that water quality and toxicity objectives were met.

The potential effects of all action alternatives on the federally endangered and special concern fish species that occur in the Gunnison and Colorado rivers would be limited mainly to water use and mine dewatering. Water withdrawals for exploration, dust control, and domestic use and mine dewatering would represent an extremely small depletion in the Gunnison and Colorado rivers, which are inhabited by Colorado pikeminnow, razorback sucker, bonytail, and humpback chub and three special concern species (flannelmouth sucker, bluehead sucker, and roundtail chub). By itself, the project-related depletions would not measurably affect flows in either occupied or critical habitat areas for the federally endangered fish species. However, the U.S. Fish and Wildlife Service considers any depletion in the Upper Colorado River Basin as potentially contributing to impacts on the endangered fish species.

Since the project area for the proposed mines is located at least 40 miles upstream from the closest occupied or critical habitat reaches for the endangered fish species (i.e., confluence between the North Fork of the Gunnison and Gunnison rivers), no additional impacts are expected. Potential increases in sedimentation or water quality changes due to fuel spills would be limited to drainages within the project study area or the North Fork of the Gunnison River.

Of the various project impacts discussed above, sediment increases and potential fuel spills could directly affect the special concern species that inhabit the lower portion of Hubbard Creek and the North Fork of the Gunnison River.

Indirect Effects - Increases in the local population as a result of all action alternatives could result in increased fishing pressure in Hubbard and Terror Creeks. If a new road is constructed along Hubbard Creek as part of exploration, new vehicle access could allow additional fishing in Hubbard Creek. It is assumed that fishermen would adhere to Colorado Division of Wildlife regulations, which restrict the number of trout harvested from these streams.

3.10.3.4 Effects of Alternative B

The direct and indirect impacts of Alternative B on aquatic resources would be the same as discussed for all action alternatives. An additional impact that could occur under Alternative B would be potential subsidence and erosion effects on Hubbard and Terror creeks, as a result of longwall mining (and subsequent subsidence) under these streams. This indirect impact could contribute sedimentation to the stream, if subsidence resulted in landslides in these drainages. Soil input to the stream also could impede flow or change the channel configuration. Aquatic habitat could be dominated by pools or ponds in areas where subsidence occurs or where large amounts of soil/rock enter the channels. However, it is important to point out that risks of subsidence and landslides would be extremely low in areas adjacent to Terror Creek. The highest risks for these types of impacts are along Hubbard Creek.

3.10.3.5 Effects of Alternative C

The direct and indirect impacts of Alternative C on aquatic resources would be the same as discussed for Alternative B. As previously mentioned, subsidence and landslide risks would be extremely low in the Terror Creek drainage. However, risks would be higher in the Hubbard Creek drainage, where past landslides have occurred. Landslides would potentially result in sedimentation impacts on aquatic communities. Flows could be impeded, if the slide blocked the channel. Impacts associated with Alternative C also would occur for an additional two to three years, as the mining period is longer for this alternative.

3.10.3.6 Effects of Alternative D

The direct and indirect impacts of Alternative D on aquatic resources would be the same as discussed for all action alternatives. See Section 3.10.3.3, Effects Common to All Action Alternatives. The duration of impacts would be two to three years longer than the No-Action scenario and Alternative B. Since no subsidence would occur under Terror or Hubbard creeks in Alternative D, the effects of sedimentation and flow impedance would not occur as discussed for Alternatives B and C.

3.10.4 Cumulative Effects

If one of the action alternatives is selected, cumulative impacts could affect aquatic communities as a result of coal exploration and mining activities, highway upgrade construction, agriculture, and logging. Potential cumulative impacts would consist of short-term, localized increases in sediment and additional water depletions (primarily related to agricultural operations). The extent of the sedimentation impacts would depend upon the effectiveness of the sediment control practices, presence of drainages near the construction area, and distance to perennial streams. New additional water withdrawals could adversely affect aquatic habitat, if they occur during the low flow periods in the summer, fall, and winter months. Aquatic habitat presently is limited in the local streams in the project area due to agricultural uses. Fuel spills also could occur, if vehicles and equipment are used near water bodies. By implementing restrictions on fueling vehicles and equipment near water bodies, potential spill risks would be reduced.

3.10.5 Possible Mitigation and Monitoring

Mitigation measures for fisheries, hydrologic balance, and spill prevention and hazardous materials would be employed. These measures would focus on maintaining acceptable water quantity and quality conditions in project area streams to protect aquatic communities. Sediment control measures would be required. The Spill Prevention Control and Countermeasures (SPCC) Plan would describe measures to be implemented to reduce impacts of potential spills or leaks on aquatic communities.

The unsuitability criterion 9 requires consultation with U.S. Fish and Wildlife Service prior to leasing lands. See Section 1.6.1, BLM Resource Management Plan Consistency; *Appendix C, Unsuitability Analysis Report - Iron Point Coal Lease Tract*; and *Appendix D, Unsuitability Analysis Report - Elk Creek Coal Lease Tract*.

Two additional effective protection measures are recommended for aquatic resources, as listed below:

- No fueling or lubricating of vehicles and other construction equipment should be allowed within 100 feet of streams or wetlands. In addition, fuel should not be stored within 500 feet of any water bodies.
- The *Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River* (Recovery Program) was established in 1988 to mitigate for water depletion impacts to federally-listed fish species. To ensure the survival and recovery of the listed species, water users are required to make a one-time payment to the Recovery Program. The one-time payment would be required if the withdrawal volume exceeds 100 acre-feet (annual average). In 1995, an intra-US Fish and Wildlife Service Biological Opinion determined that the fee for depletions of less than 100 acre-feet is no longer required (USFWS, 1995).

3.11 CULTURAL RESOURCES

Issue: *Identify cultural resources and minimize disturbance impacts to these resources. Areas of concern include the effects to historic properties listed or eligible for listing on the National Register of Historic Places.*

3.11.1 Introduction

The project area for the cultural review in this EIS includes the lands contained within and surrounding the coal exploration license and coal lease boundaries.

3.11.2 Affected Environment

3.11.2.1 Cultural Context

The RP3 prehistoric context applicable to the general project area (Reed, 1984) presents the prehistory of this region in four cultural units or stages, as follows:

- Paleo-Indian Stage (10,000-5500 B.C.),
- Archaic Stage (5500 B.C.-500 A.D.),
- Formative Stage (500 A.D.-1200 A.D.),
- Proto-Historic/Historic Stage and Ute Tradition (1200 A.D.-1881 A.D.).

More than 540 sites, representing all of these stages, have been recorded in Delta County previously (Office of Archaeology and Historic Preservation, 1996).

Cultural resource types representing these stages include various distinctive lithic and ceramic artifacts, rock art, open campsites, rock shelters and wickiups, and lithic procurement sites, among others. The differing types of cultural resources associated with each stage presumably reflect variations in general cultural adaptations and subsistence strategies over time.

The RP3 historic context for this region (Husband, 1984) presents the history of this area in terms of a number of socioeconomic themes. Themes most applicable to the current project area include early exploration and fur trade (1760-1876), Ute-Euroamerican contact (1640-1889), ranching/farming (1870-1945), railroading (1871-1934), and especially, coal mining (1872-1945).

3.11.2.2 Files Search

A computerized search of the Colorado Inventory of Cultural Resources was conducted through the Colorado State Historic Preservation Office (SHPO) on April 29, 1999. This search indicated that a number of cultural resource inventories have been conducted previously within and adjacent to the project area of potential effects, and some cultural resources have been previously recorded in this area.

3.11.2.3 Previous Surveys

SHPO records indicate that a total of 16 cultural resource surveys have been conducted previously within or partially within the current project area of potential effects. These surveys were conducted to ensure National Historic Preservation Act compliance for various projects, (e.g., coal mining/drilling, access roads, timber sales, oakbrush control, a borrow pit, pipeline, and transmission line).

These surveys were conducted between 1977 and 1998 by various entities, including Collbran-Grand Mesa-Uncompahgre-Gunnison National Forest, Colorado State University, and five regional private archaeological consulting firms. Most of these surveys were completed to intensive standards (Class III, although the comparatively recent Bowie No. 2 Mine survey (Connor, 1995) combined intensive and intuitive (Class II) survey methods.

Most of the previous surveys were relatively small, ranging from a few acres to about 50 acres in extent, although the Bowie No. 2 Mine survey contained over 800 acres. While most of the

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total acreage covered by previous surveys is apparently outside the current project area of potential effects, surveys have been conducted in portions of 17 of the 25 sections containing the project area of potential effects.

3.11.2.4 Previously-Recorded Cultural Resources

A total of 15 cultural resources have been recorded within the sections containing the current project area of potential effects. Some of these resources are referred to in this document by Smithsonian number; however, as directed by SHPO staff, information is already on file with the SHPO and Forest Service.

Most of these 15 resources are located near the extreme western periphery of the project area, generally within the East Fork of Terror Creek drainage. This distribution apparently reflects previous survey activity in this area, and is not necessarily indicative of a similar cultural resource distributional pattern within the unsurveyed portions of the project area of potential effects.

The 15 resources recorded previously within the project sections consist of eight isolated prehistoric lithic artifacts, three prehistoric open campsites, two historic corrals, one historic dugout, and one historic dumpsite.

The isolated artifacts consist of lithic reduction debris, utilized flakes, bifaces, a handstone, one fragmentary Late Archaic projectile point, and one fragmentary Late Prehistoric projectile point.

Of the 15 previously-recorded cultural resources, seven are inside the boundaries of the project area of potential effects. One of these seven is the isolated Late Prehistoric projectile point fragment noted above, 5DT163. Of the remaining five, three are open lithic sites; 5DT272, 5DT273, and 5DT868, and one is an historic dugout, 5DT699. Two of the seven cultural resources are within the project area of potential effects, 5DT273 and 5DT700, two are listed in SHPO records in the "Needs Data" category, while the others have all been field evaluated and/or officially determined not eligible for the National Register of Historic Places. The historic site known as Dove Cave is located on Forest Lands in T12S, R91W, Section 34. It has been identified as requiring protection.

3.11.2.5 Cultural Resource Potential Within Area of Potential Effects

Based on the published prehistoric and historic cultural contexts for this general region and the project-specific SHPO files search data, the project area can be presumed to have some potential for surficial cultural resources associated with any/all of the prehistoric periods and historic themes described above.

The file search produced some direct evidence of an Aboriginal presence in and adjacent to the project area during the Late Archaic and Late Prehistoric stages. Other prehistoric cultural resources are likely to exist within the project area, although the minimal previous survey data available preclude accurate prediction of their locations. If present, such resources could be useful in elucidating general patterns of prehistoric settlement/subsistence on the eastern portion of the Colorado Plateau, and might also provide chronological information leading to the establishment of absolute date/artifact associations in this region.

Historic cultural resources for which most potential within the project area could probably be anticipated would be those related to the coal mining theme. The historic King Mine site, 5DT1053, and the associated Bowie townsite, 5DT122, both located outside of, but near the southern boundary of the project area, have extensive histories dating from the turn-of-the-century era.

3.11.3 Environmental Consequences

As indicated elsewhere in this EIS, surface subsidence resulting from the expansion of underground mining is the only anticipated surface effect within the project area at this time. The amount of subsidence is expected to be so minimal as to be visually undetectable. However, sometime in the indeterminate future, visible surface impacts may be created by exploratory drilling and possible construction of mine ventilation shafts and degasification boreholes. The locations of these potential future impacts within the project area are not known at this time.

Since the only surface effect within the project area known at this time would be subsidence, it appears that none of the few known cultural resources within the area of potential effects would be discernibly affected. The one possible exception identified at this time is Dove Cave. That is within the Iron Point Lease Tract and Exploration License area. As indicated above, of the seven previously-recorded cultural resources within the project area of potential effects, 5DT273 and 5DT700, are listed in the "Needs Data" category in SHPO records. Resources in this category have been regarded as potentially eligible for the National Register of Historic Places unit evaluated otherwise. As indicated earlier, all other known cultural resources within the area of potential effects are apparently not eligible for the National Register of Historic Places.

The Bowie townsite, 5DT122, and the King Mine, 5DT1053, have both been officially determined eligible for the National Register of Historic Places. Both of these sites are outside of, but near the southern area of potential effects boundary of the project area. No impacts to these sites are expected from the exploration or mining.

3.11.4 Native American Consultation

A project description and vicinity map were sent to Betsy Chapoose, Director, Cultural Rights and Protection, Northern Ute Tribe, upon initiation of the NEPA process. No comments have been received concerning the project.

3.11.5 Management Recommendations

The historic site Dove Cave would be protected from surface disturbance including damage from subsidence (see *Appendix I, Forest Service Stipulations, Iron Point Coal Lease Tract*.) Since it appears that no other cultural resources would be affected by the proposed expansion of underground mining, no further evaluative or protective cultural resource measures are recommended at this time.

However, prior to any of the visible surface impacts (i.e., drilling, shaft construction, etc.) described above, a cultural survey of the areas to be affected is recommended. Also, if the Bowie townsite and/or King Mine, 5DT122 and 5DT1053, are to be impacted by federally-permitted action in the future, agency consultation to mitigate or minimize adverse effects to these properties is recommended. All eligible sites would be mitigated according to plans approved by the surface management agency and SHPO.

3.12 NOISE

Issue: *Identify and minimize noise impacts. Areas of concern include: levels of noise from coal transportation by truck and railroad; disruptions caused by such noise to the normal activities of adjacent residents/communities; and nighttime railroad noise in Paonia, Hotchkiss, and Delta.*

3.12.1 Introduction

Environmental noise is typically measured in A-weighted decibels (dBA). The A-weight is automatically completed by noise meters, and is a frequency-dependent sound level adjustment that simulates the sensitivity of human hearing at various sound frequencies. *Figure 25, Noise Levels Caused by Typical Activities*, shows the noise levels generated by familiar operations.

The dBA sound level scale is a logarithmic rather than a linear scale, so the dBA reading is not directly related to the actual energy of the sound. The smallest clearly discernible noise level increase is about 3 dBA, which corresponds to a doubling of the sound energy. A 10-dBA noise increase is perceived as a doubling of the judged loudness. For example, one bulldozer typically generates a sound level of about 80 dBA at a distance of 50 feet. Two bulldozers side-by-side would give a noise reading of 83 dBA, and would be perceived as barely louder than one bulldozer. Ten bulldozers side-by-side would give a noise reading of 90 dBA, and would be perceived as twice as loud as one single bulldozer.

The environmental impact of a given noise level depends partially on the noise duration. For this EIS, the following noise level descriptions are used to assess noise impacts.

- 1-hour Equivalent Noise Level L-eq(h). During any given hour, the instantaneous noise level usually fluctuates. The L-eq is the single noise level that equates to the average sound energy during the 1-hour averaging period. The L-eq(h) is the noise descriptor that is used in the Colorado state noise regulation, and is used by the Federal Highway Administration to evaluate traffic noise.

- 24-hour Day-Night Noise Level L-dn. The L-dn is the weighted average of the individual hourly L-eq values during a 24-hour day, adjusted by adding a 10 dBA factor to the L-eq readings during nighttime hours (10:00 p.m. to 7:00 a.m.) to account for the fact that noise is more annoying at night. The L-dn is used by the Federal Transit Administration to evaluate highway noise and railroad noise.

3.12.2 Noise Regulations and Guidelines

3.12.2.1 Colorado Noise Emission Limits

The state of Colorado has noise regulations that specify allowable daytime and nighttime noise limits (Colorado Regulation 25-12 Article 12, "Noise Abatement"). The Colorado noise regulation differs significantly from most state and local noise regulations typically found in the United States. Most noise regulations typically limit the noise levels at the receiving property (e.g., 50 dBA allowable daytime noise level at the property line of a residence). However, the Colorado noise regulations restrict noise emissions radiating from an industrial facility, regardless of how far it is to the closest receiving residential property. The following noise emission limits apply at a point 25 feet from any industrial facility's property line:

The Colorado noise emission limits do not apply to traffic traveling along public highways. However, the regulation explicitly applies to railroads, with the railroad right-of-way specifying the "facility boundary".

3.12.2.2 Noise Guidelines for Federally-Funded Transit Projects (Highways and Railroads)

The federal Department of Transportation and its sub-agency, the Federal Transit Administration have established non-binding guidelines to define unacceptable noise impacts in EIS documents that involve federally-funded highway, railroad, and airport projects (FTA, 1995). Note that these regulations do not directly apply to trucks or coal trains associated with the coal mines for this EIS because the proposed exploration and mining activities would not receive federal funding. However, the FTA noise guidelines are presented here to describe a relevant set of criteria that can be used to qualitatively rank the noise impacts caused by increased usage of haul trucks and coal trains.

The Federal Transit Administration noise criteria are based on a series of historical studies that evaluated public annoyance caused by noise increases (EPA, 1974). Those studies indicated that, when the existing noise levels are low, it takes a large increase in the noise level to cause an adverse public reaction. However, when the existing noise level is already high, it requires only a small increase in the noise level to produce significant annoyance.

Based on these historical studies, The Federal Transit Administration developed a "sliding scale" set of criteria to define three noise descriptors: "no impact"; "impact"; and "severe impact". For residential areas, the FTA criteria are based on the 24-hour weighed-average L-dn. *Figure 26, Federal Transit Administration Noise Impact Criteria for Highway Traffic and Railroad Projects*, shows the impact criteria.

Another noise criterion that has no legal applicability to the proposed exploration and mining activities (but which provides a relevant criterion for assessing environmental impacts) is the recommended maximum 1-hour L-eq noise level that is used by the Federal Highway Administration (FHWA, 1995). For federally-funded projects, the Federal Highway Administration requires installation of noise mitigation if a proposed highway project causes a maximum hourly noise level (L-eq(h)) exceeding 67 dBA at any residential property.

3.12.3 Affected Environment (Background Noise Levels)

Background noise level measurements at representative locations around the project site were taken on April 21, 1999 and April 23, 1999. The measurements were taken using a hand-held noise monitor (Larson-Davis Model 720) that was set for A-weighting and "slow" response. The monitor has a detection range of about 25 dBA to 120 dBA. The weather conditions during the noise monitoring were cool with little wind.

For this EIS, the term "background noise" implies the noise levels that would exist if all of the mining operations were operating at their normally expected production rates as of April, 1999.

Background Noise Measurements at Rural Locations. *Table 3.12-1, Measured Noise Levels at Rural Areas Near Paonia,* lists the measured background values that were taken during brief periods when there were no mine-related trucks or trains. All of the measurements were "spot check" values taken using the hand-held meter over an averaging time of 10 seconds to 10 minutes. Rural background measurements were taken during the daytime and nighttime at two locations on Garvin Mesa and at one location next to State Highway 133. Daytime and nighttime background noise readings were taken at several locations in Paonia and Hotchkiss. Some of the monitoring stations at Paonia and Hotckhiss were later used to measure noise levels caused by passing coal trains.

In general, the background noise measurements were as expected. The quietest measurements taken at night on Garvin Mesa were only 36 dBA, with the predominant noises being natural bird sounds. Routine daytime noise levels in the urban residential areas were 48 to 56 dBA with predominant sounds produced by routine local traffic. At the rural site near State Highway 133, the spot check measurements showed 41 to 49 dBA during brief periods of no discernible traffic and spot noise levels of 64 dBA during the brief period while a coal truck drove past.

3.12.3.1 Noise Levels at Rural Locations During Train Loading

The No-Action Alternative includes routine train loading at the Bowie No. 1 Loadout near Paonia and the Oxbow coal loading facilities near Somerset. For this assessment, the noise emissions from coal train loading were limited to measurements of the Bowie No. 1 Loadout, because the Oxbow mining facility had been temporarily shut down. *Table 3.12-1, Measured Noise Levels at Rural Areas Near Paonia*, lists the noise levels that were measured at the residence closest to the Bowie No. 1 Loadout while a coal train was being loaded. At one location that did not have a direct line-of-sight with the loading facility, the noise level during loading was minor (39 dBA) and the mechanical noise caused by the loading was barely discernible. At a second residential location with a nearly line-of-sight view of the loading facility, the noise level was 49 dBA, and the mechanical noise was quiet but clearly audible during the pre-dawn hours. However, the measured daytime background level (without any train loading) at that same location was 55 dBA, so it is assumed that the noise from train loading would be either inaudible or barely discernible during the daytime.

3.12.3.2 Noise Levels at Paonia and Hotchkiss Without Coal Trains

Table 3.12-2, Measured Background Noise Levels at Paonia and Hotchkiss, lists the background daytime and nighttime noise levels at the two townsites. Nighttime L-eq noise levels ranged from 35 to 41 dBA, with predominant noises produced by distant traffic and by water flowing in distant creeks. Daytime L-eq noise levels ranged from 48 to 56 dBA, with predominant noises produced by normal residential and commercial traffic.

3.12.3.3 Train Noise Levels

The No-Action Alternative includes coal trains passing through the towns of Paonia and Hotchkiss, originating from the three local coal mines. A series of noise measurements were taken near the railroad tracks in Paonia and Hotchkiss. The purpose of the coal train noise measurements was to develop the maximum hourly-average L-eq for assessing compliance with the Colorado noise regulation, and to develop the 24-hour average L-eq for assessing the impact using the FTA noise impact criteria.

Table 3.12-1
Measured Noise Levels at Rural Areas Near Paonia

Time of Day	Condition	Noise Levels in dBA				Predominant Noises
		L-eq	L-25	L-50	L-90	
Residence at 1660 4100 Road (Closest Residence to Bowie No. 1 Rail Loading Facility)						
4/21/99; 16:25	Back patio, line of sight to truck unloading silos; est. 1,500 feet away from silos	55	58	54	50	Traffic on Highway 153; fan noise from truck unloading facility
4/23/99; 04:35	Front yard during period of no train or truck activity	35	35	34	34	Very quiet; distant highway noise
4/23/99; 07:44	Front yard during train loading; no line of sight to train facility; est 3,000 feet to train loading facility	39	40	38		Barely discernible mechanical noise from train loading; minor highway noise
4/23/99; 07:53	Back patio during train unloading; closest to train loading station; est 3,000 feet to train loading facility	49	50	49		Quiet but clearly discernible mechanical noise from train loading; minor highway noise; birds
Terror Creek Winery, No Line of Sight to Highway or Train Loading						
4/21/99; 15:06	Daytime; no line of sight to any industrial activity	53	53	48	40	Birds, breeze in trees
4/23/99; 07:30	Early morning during coal loading at Bowie No. 1 coal facility	44	43	40	37	No discernible coal facility noise; birds, water flowing in ditch
Traffic Noise From highway 153, Taken at "Colorado Western Slope Counseling" 150 Feet From Highway						
4/21/99; 17:18	Noise without any passing vehicles	41-49				River sounds, birds, etc.
	Cars and pickup trucks	53-59				Maximum noise during car passage
	Coal trucks	62-64				Maximum noise during truck passage

The locations of the noise measurement stations and a summary of the measured train noise levels are shown in the following figures:

- *Figure 27, Train Noise at Paonia (4/21/99)*;
- *Figure 28, Train Noise at Paonia (4/25/99)*; and,
- *Figure 29, Train Noise at Hotchkiss (4/21/99 and 4/25/99).*

Table 3.12-2
Measured Background Noise Levels at Paonia and Hotchkiss

Time of Day	Condition	Noise Levels in dBA				Predominant Noises
		L-eq	L-25	L-50	L-90	
Paonia Receiver P-1: Main Street; ½ Block (115 Feet) From RR Tracks						
4/22/99 13:16	Daytime Baseline	58	52	49	44	Birds; distant traffic
4/23/99 04:10	Nighttime Baseline	36	36	36	36	Distant exhaust fan; distant creek
4/23/99 late a.m.	Westbound (full) train	61	60	56	–	Slow-moving train
Calc'd L-dn		81	–	–	–	
Paonia Receiver P-2: 118 Main Street; 1 ½ Block (490 Feet) From RR Tracks						
4/22/99 13:10	Daytime baseline	48	48	44	41	Birds; distant traffic; distant carpentry
4/23/99 04:00	Nighttime baseline	41	41	38	36	Distant exhaust fan; distant creek
4/23/99 late a.m.	Westbound (full) train	56.5	56	54	–	Train noise was barely distinguishable from other noises in the area
Calc'd L-dn		51	–	–	–	
Paonia Receiver P-3; 224 Main Street; 2 ½ Blocks (900 Feet) From RR Tracks						
4/22/99 13:03	Daytime Baseline	51	51	49	48	Birds; distant traffic
4/23/99 04:15	Nighttime Baseline	40	41	39	36	Distant drainage ditch; distant exhaust fan
Hotchkiss Receiver H-2; 4th Street and High Street; 1 Block (240 Feet) From RR Tracks						
4/22/99 12:25	Daytime Baseline	48	47	45	43	Distant traffic, birds, distant carpentry
4/23/99 03:30	Nighttime Baseline	36	37	36	35	Distant creek, distant traffic
Hotchkiss Receiver H-3; 4th Street and Orchard Street; 2 Blocks (550 Feet) From RR Tracks						
4/22/99 12:28	Daytime Baseline	50	50	48	47	Distant traffic, birds, distant dog
4/23/99 03:30	Nighttime Baseline	35	36	35	33	Distant drainage ditch, distant traffic

The monitoring locations were selected to provide a reasonable sample of the types of residences that could be impacted by train noise. Some of the monitoring locations were at unoccupied spots within 30 feet of the tracks that accurately define the noise emissions from the train, but to not reflect actual noise exposure by residents. Other monitoring locations represent homes located within the first block of the tracks, with minor shielding from adjacent buildings. Finally, some monitoring locations represent homes located more than one block from the tracks, with the majority of the noise shielded by adjacent buildings.

Noise measurements were taken on two days to measure eastbound (empty) trains and westbound (full) trains. Eastbound (empty) trains are carrying their load slightly uphill, and they were measured to be considerably louder than the westbound (full) trains that travel slightly downhill.

3.12.4 Environmental Consequences

3.12.4.1 Summary of Noise Impacts

The noise impacts caused by operations at Oxbow and Bowie are summarized in *Table 3.12-3, Summary of Noise Impacts Caused by Oxbow Mining* and *Table 3.12-4, Summary of Noise Impacts Caused by Production Increase at Bowie Resources.*

Table 3.12-3
Summary of Noise Impacts Caused by Oxbow Mining

Project Item	Impacts to Valley Towns (Somerset, Paonia, Hotchkiss)	Impacts to Nearby Rural Residents
New portal construction	Minor impact. Construction noise would be temporary. Noise levels at Somerset would probably be less than 1 dBA above nighttime background.	Not applicable. There are no residents near the portal sites.
New portal operation (fans and conveyors)	Minor impact. Portal fans and new conveyor might be discernible at Somerset, but noise levels would probably be less than 1 dBA above nighttime background.	Not applicable. There are no residents near the portal site.
Beaver Creek vent raise fan	No impact. Vent raises would not be audible at any town sites	Minor impact. Vent raise noise might be barely discernible at homes in the valley on an infrequent basis during exceptionally quiet periods.
Increased surface operations (Not applicable - proposed action would not result in increased surface operations)	Not applicable	Not applicable
Increased coal train traffic (Not applicable - proposed action would not increase annual rail traffic)	Not applicable	Not applicable

The mining equipment at the Bowie No. 2 Mine causes little direct noise impacts at the nearest homes. However, the coal handling facilities of Oxbow possibly exceeds the state of Colorado noise emission limits, and possibly causes noise impacts at the nearest homes in Somerset.

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Table 3.12-4
Summary of Noise Impacts Caused by Production Increase at Bowie Resources

Project Item	Impacts to Valley Towns (Somerset, Paonia, Hotchkiss)	Impacts to Nearby Rural Residents
Construction of new conveyor and truck loading facility	Negligible. Construction noise would not be audible at the town sites.	Minor impact. Construction noise would be discernible at a limited number of rural homes.
Increase surface operations at upper mine site	Negligible. Routine operations would not be audible at the town sites.	Negligible impact. Noise from the upper mine site might be barely discernible at some rural homes during periods of exceptionally quiet background.
Noise from new conveyor and lower truck loading facility	Negligible. Truck loading would not be audible at the town sites.	Negligible impact. Noise from the new conveyor would increase nighttime noise levels at some rural homes during periods of exceptionally quiet background. The 24-hour L-dn noise level would probably increase by less than 1 dBA.
Increased coal truck traffic and commute vehicles along State Highway 133	Negligible. Coal trucks will not routinely travel through Paonia or Hotchkiss	Negligible impact. Increased coal trucks are modeled to cause an L-dn noise increase of only 3 dBA at homes along State Highway 133.
Increase usage of train loading facility	Negligible. Train loading would not be audible at urban areas of Paonia	Minor impact. Noise levels at the facility boundary comply with the Colorado noise emission limits. Nighttime noise levels at rural homes nearest the train loading facility increase to about 49 dBA during the 2-hour loading period. The train loading noise is probably inaudible during the day, and is discernible but not intrusive at night
Increased coal train traffic	Significant impact adjacent to the tracks, and negligible impact at homes partially shielded by other structures. Existing L-dn noise levels at homes adjacent to the tracks	

Issuance and subsequent mining of the Iron Point and Elk Creek Coal Lease Tracts would increase the number of coal trains passing through Paonia and Hotchkiss as compared to the No-Action Alternative. Homes next to the tracks with no shielding by adjacent buildings are subjected to severe noise impacts. However, the increase in coal trains would have either a minor impact or no impact on homes more than about one-half block from the tracks with reasonable shielding by adjacent buildings.

Issuance and subsequent mining of the Iron Point Coal Lease Tract would increase the number of coal trucks traveling on State Highway 133 between the Bowie No. 2 Mine and the Bowie No. 1 Loadout. Noise from the increased coal trucks would cause a noise impact at homes closer than about 200 feet to the highway.

3.12.4.2 Effects of Alternative A (No-Action)

Noise Impacts During Construction - Temporary noise impacts would occur during construction of the new Elk Creek Mine portal and associated facilities. Conventional construction equipment is expected to be used. The construction noise would probably be barely discernible at the town of Somerset. The construction noise would also be barely discernible at a distance of several miles in the unpopulated areas surrounding the construction sites.

Noise Levels from Mining Equipment - There would be no significant change in the mode of operation or the hours of operation for the surface facilities at Oxbow or Bowie. Therefore, there would be no net increase in the noise levels generated by these mining operations. However, with projected coal production increases from the mines in the North Fork valley, there would be an increase in the number of coal trains traveling through Paonia and Hotchkiss, with a corresponding increase in noise impacts.

L-dn Noise Levels Caused by "No Action" Coal Trains - The Federal Transit Administration noise impact criteria are based on the 24-hour average L-dn. It was not practical to conduct 24-hour measurements to directly measure the L-dn caused by coal trains, because the Oxbow Sanborn Creek Mine had been inactive because of a mine fire during the spring of 1999 when noise measurements were being taken.

Therefore, the L-dn noise levels at the representative residential locations were calculated from the measured baseline measurements and the estimated number of daily train passages. *Table 3.12-5, Assumed Coal Trains Used for Noise Calculations*, lists the assumed coal production at each of the three local mines and calculates the number of coal train passages per year for the combined three mines. A total of 10,500 trains per year (3.6 trains per day) are assumed to load at the mines for the "No-Action" alternative. For these calculations a coal train duration of 5 minutes per passage is assumed, based on measurements on April 21 and 25, 1999.

Table 3.12-5
Assumed Coal Trains Used for Noise Calculations

Item	Assumed Value for "No-Action Alternative"	Assumed Value for Action Alternatives
Oxbow Mining Production Rate	1.8 tons/year	5.0 tons/year
Bowie No. 2 Production Rate	5.0 tons/year	6.0 tons/year
Mountain Coal Production Rate	7.0 tons/year	8.2 tons/year
Combined Production Rate for 3 Regional Mines	13.8 tons/year	19.2 tons/year
Coal Train Payload	10,500 tons/train	10,500 tons/train
Number of Daily Coal Trains	3.6 eastbound 3.6 westbound	5.0 eastbound 5.0 westbound
Duration of Train Passage	4 to 6 minutes	4 to 6 minutes

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Table 3.12-6, Calculated L-dn Train Noise at Paonia (No-Action), and *Table 3.12-7, Calculated L-dn Train Noise at Hotchkiss (No-Action)*, show the calculated L-dn values at each of the measurement locations in Paonia and Hotchkiss. For these calculations, the following assumptions were made:

- The single "daytime background" and the single nighttime" background represent the average noise levels during the 15 hour daytime period (from 7 a.m. to 10 p,m,) and the 9 hour nighttime period (from 10 p.m. to 7 a.m.).
- The total daily duration of coal train passages is listed in *Table 3.12-5, Assumed Coal Trains Used for Noise Calculations.*
- Half of the coal trains are assumed to pass in the daytime, and half are assumed to pass during the nighttime.
- The 24-hour L-dn was calculated by adding 10 dBA to the nighttime background values and the nighttime train passages.

L-dn Noise Levels Near State Highway 133 Caused by "No-Action" Coal Trucks - The No-Action Alternative includes coal trucks traveling along State Highway 133 between the Bowie No. 2 Mine and the Bowie No. 1 Loadout. The STAMINA computer model developed by the Federal Highway Administration was used to estimate the hourly-average noise levels and the 24-hour L-dn noise level at two representative receiver locations located 100 feet and 200 feet from the highway.

Annual average daily traffic (ADT) vehicle counts for 1996 for State Highway 133 were obtained from the Colorado Department of Transportation. The ADT at Paonia was 3,150 vehicle passes per day. The ADT data do not include a breakdown of cars vs. trucks. For purposes of calculating the daytime and nighttime noise impacts, the following assumptions were made:

- The coal trucks were assumed to operate 24 hours per day. The "No-Action" coal truck usage is 196 coal trucks per day corresponding to a production rate of 2 million tons per year. The "Proposed Action" coal truck usage is 489 coal trucks per day corresponding to a production rate of 5 million tons per year.
- Non-project vehicles were divided into the following categories: 70 percent cars; 20 percent medium trucks; and 10 percent heavy trucks.
- It was assumed that the daytime hourly rate of non-project vehicles was twice the nightly hourly rate.
- The number of delivery trucks was estimated to increase threefold for the "Action Alternatives" while continuing to operate over an 8-hour day shift. It was also estimated there would be three times as many mine commuters for the "Action Alternatives", and that they would now travel 24 hours per day.

Table 3.12-8, Noise Impacts of Traffic on State Highway 133, lists the assumed daytime and nighttime traffic volumes for "No-Action" and "Action Alternatives".

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Table 3.12-6
Calculated L-dn Train Noise at Paonia
(No-Action)

Time of Day		Hrs	L-eq	Night Factor	Net dBA	Factor P10^L
Receiver P-1; Main Street; ½ Block (115 Feet) From RR Tracks						
Day baseline		14.699	56	0	56	2.E+05
Night baseline		8.899	38	10	48	1.E+04
Day westbound train	Based on field measurement	0.15	61	0	61	8.E+03
Night westbound train		0.15	61	10	71	8.E_04
Day eastbound train	Assume eastbound train is 10 dBA louder than westbound train, based on field measurements at Hotchkiss	0.15	71	0	71	8.E+04
Night eastbound train		0.15	71	10	81	8.E+05
Total		24	--	--	--	1.E+06
Calc'd L-dn		--	--	--	--	60.8
Receiver P-2; 118 Main Street; 1 ½ Blocks (490 Feet) From RR Tracks						
Day baseline		14.899	48	0	48	4.E+04
Night baseline		8.899	41	10	61	5.E+04
Day train	Based on field measurement	0.3	56.4	0	58.4	5.E+04
Night train		0.3	56.4	10	66.4	5.E+04
		0	0	0	0	0.E+00
		0	0	0	0	0.E+00
Total		24	--	--	--	1.E+05
Calc'd L-dn		--	--	--	--	51.8
Receiver P-3; 224 Main Street; 2 ½ Blocks (900 Feet) From RR Tracks						
Day baseline		14.899	51	0	51	8.E+04
Night baseline		8.899	40	10	50	4.E+04
Day train	Based on field measurement	0.3	58	0	56	5.E+03
Night train		0.3	58	10	66	5.E+04
		0	0	0	0	0.E+00
		0	0	0	0	0.E+00
Total		24	--	--	--	2.E+05
Calc'd L-dn		--	--	--	--	52.3

Table 3.12-6
Calculated L-dn Train Noise at Paonia
(No-Action)

Time of Day		Hrs	L-eq	Night Factor	Net dBA	Factor P10^L
Receiver P-4; 2nd Street; ½ Block (30 Feet) From RR Tracks						
Day baseline	Assume same as Main Street baseline measurement	14.899	58	0	56	2.E+05
Night baseline		8.899	38	10	45	1.E+04
Day eastbound train	Based on field measurement	0.15	100	0	100	6.E+07
Night eastbound train		0.15	100	10	110	6.E+08
Day westbound train	Assumed to be 10 dBA quieter than eastbound train	0.15	80	0	90	8.E+08
Night westbound train		0.15	80	10	100	8.E+06
Total		24	--	--	--	8.E+08
Calc'd L-dn		--	--	--	--	89
Receiver P-5; 2nd Street and Box Elder Avenue; 1 ½ Blocks (270 Feet) From RR Tracks						
Day baseline	Assume same as Main Street baseline measurement	14.899	58	0	56	2.E+05
Night baseline		8.699	36	10	46	1.E+04
Day train	Based on field measurement	0.3	57	0	57	6.E+03
Night train		0.3	57	10	67	6.E+04
		0	0	0	0	0.E+00
		0	0	0	0	0.E+00
Total		24	--	--	--	3.E_05
Calc'd L-dn		-	--	--	--	55.1
Basis for Train Duration: 13.8 million tons of coal per year produced by 3 regional mines; 3.8 trains per day each direction; 5 minutes average train duration per passing.						

Table 3.12-7
Calculated L-dn Train Noise at Hotchkiss
(No-Action)

Time of Day		Hrs	L-eq	Night Factor	Net dBA	Factor P10'L
Receiver H-1; 4th Street; 40 Feet From RR Tracks						
Day baseline	Assume same as H-2	14.70	48	0	46	4.E+04
Night baseline	Assume same as H-2	8.70	36	10	46	1.E+04
Day eastbound train	Based on field measurement	0.15	98	0	98	4.E+07
Day westbound train	Based on field measurement	0.15	84	0	84	2.E+08
Night eastbound train	Based on field measurement	0.15	98	10	108	4.E+08
Night westbound train	Based on field measurement	0.15	84	10	94	2.E+07
Total		24.00	--	--	--	5.E+08
Calc'd L-dn		--	--	--	--	88.5
Receiver H-2; 4th Street and High Street; 1 Block (240 Feet) From RR Tracks						
Day baseline	Based on field measurement	14.70	48	0	48	4.E+04
Night baseline	Based on field measurement	8.70	36	10	48	1.E+04
Day eastbound train	Based on field measurement	0.15	62	0	62	1.E+04
Day westbound train	Based on field measurement	0.15	76	0	76	2.E+05
Night eastbound train	Based on field measurement	0.15	62	10	72	1.E+05
Night westbound train	Based on field measurement	0.15	76	10	86	2.E+08
Total		24.00	--	--	--	3.E+08
Calc'd L-dn		--	--	--	--	64.8
Receiver H-3; 4th Street and Orchard Street; 2 Blocks (660 Feet) From RR Tracks						
Day baseline	Based on field measurement	14.70	50	0	50	5.E+04
Night baseline	Based on field measurement	8.70	35	10	45	1.E+04
Day eastbound train	Based on field measurement	0.15	51	0	51	8.E+02
Day westbound train	Based on field measurement	0.15	53	0	53	1.E+03
Night eastbound train	Based on field measurement	0.15	51	10	61	8.E+03
Night westbound train	Based on field measurement	0.15	53	10	63	1.E+04
Total		24.00	--	--	--	1.E+05
Calc'd L-dn		--	--	--	--	49.8

Basis for Train Duration: 13.8 million tons of coal per year produced by 3 regional mines; 3.8 trains per day each direction; 5 minutes average train duration per passing.

Table 3.12-8
Noise Impacts From Traffic Along State Highway 133

	No-Action		Proposed Action	
	Day (veh/hr)	Night (veh/hr)	Day (veh/hr)	Night (veh/hr)
Non-project Vehicles				
Cars	113	57	113	57
Medium Trucks	32	16	32	16
Heavy Trucks	16	8	16	8
Total Non-project Vehicles	161	81	161	81
Project: Coal Trucks	15	15	40.75	40.75
Project: Delivery Trucks	1.25	--	3.75	--
Project: Mine Commuters	12.5	--	12.5	12.5
Total Cars	126	57	126	70
Total Medium Trucks	33	16	36	16
Total Heavy Trucks	31	23	57	49
TOTAL VEHICLES	**190**	**96**	**219**	**135**
$L_{eq(h)}$ (dBA) (100 ft/200 ft)	65/60	63/58	67/62	66/61
L_{dn} (dBA) (100 ft/200 ft)	70/65		73-68	
FTA Impact Descriptor at 100-ft for Proposed Action - No-Action				Impact
FTA Impact Descriptor at 200-ft for Proposed Action - No Action				Impact

The FHWA Highway Traffic Noise Prediction Model was used to determine the existing and future noise exposure. The model calculates the 1-hour L-eq(h)noise level at a single receptor. Receptors were assumed to be located at points 100 feet and 200 feet from the highway. The model was run at each receptor location for both daytime and nighttime traffic volumes.

The L-eq(h)s calculated by the model was used to estimate the Day-Night Sound Level (L-dn) for both the existing and future conditions.

The calculated 1-hour L-eq(h)s and the modeled L-dn values are listed in *Table 3.12-8, Noise Impacts of Traffic on State Highway 133*. For the "No-Action" traffic volumes, the maximum 1-hour L-eq(h) at distances of 100 feet and 200 feet were 65 and 61 dBA, respectively. Both 1-hour L-eq(h) values were well below the 67 dBA criterion that the FHWA defines as a "significant impact".

3.12.4.3 Effects of Alternative B

Noise Impacts During Exploration - Exploration drilling in the Iron Point exploration license area would generate noise. Based on observations at other exploration projects, noise from the drill rigs is expected to be barely audible at a distance of two to three miles during quiet parts of the day. It is unlikely that the noise levels at any homesites would be more than 1 dBA above the daytime background.

Noise Impacts Caused by Surface Facilities - The measured noise emissions from mining equipment and coal train loading equipment are listed in *Table 3.12-9, Measured Noise Emissions From Mining Activities.* All of the measurements were taken at the Bowie facilities because the Oxbow Mine was temporarily shut down at the time of measurement.
The surface facilities at the Bowie No. 2 Mine range from 500 feet to over 3,000 feet from the facility boundary. As listed in *Table 3.12-10, Predicted Noise Levels at Mine Site Boundaries and Comparison with Colorado Noise Limits*, the estimated noise levels at the Bowie No. 2 Mine boundary are well below the Colorado noise limits. The noise from the Bowie No. 2 Mine is expected to be barely discernible at the nearest homesites.

The Bowie No. 1 Loadout is next to State Highway 133 and is within 3,000 feet of nearby homes. As shown in *Table 3.12-10, Predicted Noise Levels at Mine Site Boundaries and Comparison with Colorado Noise Limits*, the noise levels at the facility boundary are estimated to be less than the Colorado limits. As shown in *Table 3.12-1, Measured Noise Levels at Rural Areas Near Paonia*, the noise caused by train loading was clearly discernible at the nearest residence during the quiet pre-dawn hours.

The surface facilities at the Oxbow Mine (other than the train loading facility) are about 800 feet from the property line next to the town of Somerset. The noise levels at Somerset caused by the Oxbow Mine operations were calculated based on the field measurements that were taken at the Bowie facilities. As listed in *Table 3.12-10, Predicted Noise Levels at Mine Site Boundaries and Comparison with Colorado Noise Limits*, the estimated noise levels at the Oxbow Mine boundary are well below the Colorado noise limits. The noise from the Oxbow activities is expected to be clearly discernible at the nearest homes in Somerset, but are not expected to be loud enough to be disruptive.

The train loading facility at the Oxbow facility is only about 100 feet from the facility boundary and about 200 feet from the nearest homes. As listed in *Table 3.12-10, Predicted Noise Levels at Mine Site Boundaries and Comparison with Colorado Noise Limits*, the estimated noise level at the boundary during the 2-hour operation of the train loading facility would be 79 dBA, which exceeds the Colorado noise limit for nighttime operation. The noise from the Oxbow operation at the nearest home is estimated at 73 dBA. That noise level is higher than the 67 dBA noise criterion that the FHWA describes as a "significant impact".

Noise Impacts by New Ventilation Facilities - New ventilation facilities would include above-ground fans housed in weatherproof structures. Based on observations of the ventilation fans operated on the south side of the Gunnison River by the West Elk Mine, it is expected that the new fans operated by Oxbow and Bowie would generate a "white noise" sound that would be barely discernible at a distance of 3 to 4 miles. It is unlikely that the fans would be discernible at homesites near Paonia or Somerset.

Noise Impacts Caused by Increased Coal Trains - The measured 30-second average train noise levels during train passages through Paonia and Hotchkiss are described in *Table 3.12-11, Measured 30-Second Noise Levels Caused by Coal Trains*. The calculated 24-hour L-dn noise levels that would occur for the Action Alternatives are listed in *Table 3.12-12, Calculated L-dn Train Noise at Paonia (Action Alternatives)*, and *Table 3.12-13, Calculated L-dn Train Noise at Hotchkiss (Action Alternatives)*. *Table 3.12-14, Action Alternatives vs. No-Action Coal*

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Table 3.12-9
Measured Noise Emissions From Mining Activity

Time of Day	Condition	Noise Levels in dBA				Predominant Noises
		L-eq	L-25	L-50	L-90	
Mining and Coal Processing Activities at Upper Surface Facility						
4/25/99 p.m.	Coal conveyor discharge onto coal pile; 70 feet distance	79				
	Coal crusher; 100 feet distance	81				
	Covered coal conveyor from mine to crusher; 25 feet distance	79				high-pitched clanging of rollers and belt
	Coal stacker tower discharging onto open coal pile; 80 feet distance	82				high-pitched noise
	General facility noise without coal stacker; 250 feet from center of activity	75				
	General facility noise including coal stacker tower; 150 feet from tower	82				Coal stacker was the loudest noise at the facility
Noise From Upper Surface Facility, Measurements Taken at Mine Office at Bottom of Valley; 3,200 Feet From Upper Facility						
4/25/99 p.m.	Combined surface operations not including coal stacker tower	41				Mine noise was barely discernible when coal stacking tower was not operating
	Coal stacker tower and other combined surface operations	46				Coal stacker was the loudest noise at the facility
Coal Train Loading at Bowie No. 1 Train Facility; Measurements Taken From Road 4175; 1,600 Feet From Train Loading						
4/25/99 06:00	Coal train backing into facility	57				Spot reading
4/25/99 07:00	Coal train loading	54.8	55.3	54.6		Coal loading; traffic on Highway 153

Table 3.12-10
Predicted Noise Levels at Mine Site Boundaries and Comparison With Colorado Noise Limits

Mining Operations	Approximate Distance to Facility Boundary	Predicted or Measured Noise Level at Facility Boundary (dBA)	Colorado Noise Limits
Bowie No. 1 Coal Train Loading Facility	150 feet	76 dBA	Daytime = 80 dBA Nighttime = 75 dBA
Bowie No. 2 Mine; New Coal Conveyor	500 feet	69 dBA	Daytime = 80 dBA Nighttime = 75 dBA
Bowie No. 2 Mine; Upper Surface Operations	3,500 feet	45 dBA	Daytime = 80 dBA Nighttime = 75 dBA
Oxbow Mine Coal Train Loading Facility	100 feet	79 dBA	Daytime = 80 dBA Nighttime = 75 dBA
Oxbow Mine Surface Operations	800 feet	68 dBA	Daytime = 80 dBA Nighttime = 75 dBA
Coal Trains Passing Through Residential Areas	200 feet to right-of-way	95 to 100 dBA for 4 to 6 minutes per train. 1-hour average L-eq is 87 dBA to 89 dBA	Daytime = 90 dBA Nighttime = 75 dBA

Train Noise in Paonia and Hotchkiss, lists the calculated noise increases caused by increased coal train traffic.

The coal trains do not comply with the noise emission limits set by the state of Colorado. As listed in *Table 3.12-10, Predicted Noise Levels at Mine Site Boundaries and Comparison With Colorado Noise Limits*, the average 1-hour L-eq noise levels produced by the coal trains exceed the allowable Colorado noise emission limits that apply 25 feet outside the right-of-way.

There is no regulatory limit for train noise impacts to residential neighborhoods. For this EIS, the noise impacts caused by incremental increases in train traffic between the Action Alternatives and No-Action Alternatives were assessed using the impact criteria developed by the Federal Transit Administration for federally-funded railroad projects and the Federal Highway Administration for federally-funded road projects. Those criteria impose no legal restrictions on privately-funded actions, but they offer a relevant set of environmental criteria for use in describing impacts.

Figure 30, Noise Impact Descriptors Using Federal Transit Administration Criteria, shows how the Federal Transit Administration criteria were used to assess the impacts of the noise increases. The results and conclusions are as follows:

Homes Next to Tracks: Severe Impact. Homes within roughly 100 feet of the railroad tracks with no shielding by adjacent buildings are exposed to a "severe impact". The 30-second L-eq noise levels during a train passage were as high as 100 dBA. The 1-hour L-eq noise levels there exceed the 67 dBA FHWA criterion, and the No-Action L-dn noise level is "off the chart" for the Federal Transit Administration noise criteria.

Table 3.12-11
Measured 30-Second Noise Levels Caused by Coal Trains

Location	Orientation to Tracks	Daytime Baseline Noise Level Without Trains (dBA)	Nighttime Baseline Noise Level Without Trains (dBA)	Noise Level During Passing Coal Train (dBA, Leq for 3-5 minutes)
P-1 (Paonia) Residence Near First and Main, outdoors	115 ft from tracks; partially shielded by neighboring houses	56	36	61 (westbound)
P-2 (Paonia) Residence, 118 Main Street	490 ft from tracks, mostly shielded by neighboring houses	48	41	57 (westbound)
P-3 (Paonia) Residence, 224 Main Street	800 ft from tracks, entirely shielded by neighboring houses	51	40	56 (westbound)
P-4 (Paonia) Non-residential Location on Sidewalk on 2nd Street	30 ft from tracks, with unobstructed exposure to train noise	56	36	100 (eastbound)
P-5 (Paonia) Residence Near 2nd Street and Box Elder Ave.	270 ft from tracks, partially shielded by neighboring houses	56	36	57 (eastbound)
H-1 (Hotchkiss) Non-residential Location on Sidewalk on 4th Street	40 ft from tracks with unobstructed exposure to train noise	48	36	98 (eastbound) 84 (westbound)
H-2 (Hotchkiss) Residence Near 4th Street and High Street, outdoors	240 ft from tracks, partially shielded by neighboring houses	48	36	76 (eastbound) 62 (westbound)
H-3 (Hotchkiss) Residence Near 4th Street and Orchard Street, outdoors	550 ft from tracks, entirely shielded by neighboring houses	50	35	53 (eastbound) 51 (westbound)

Table 3.12-12
Calculated L-dn Train Noise at Paonia
(Action Alternatives)

Time of Day		Hrs	L-eq	Night Factor	Net dBA	Factor P10'L
Receiver P-1; Main Street; ½ Block (115 Feet) From RR Tracks						
Day baseline		14.58	56	0	56	2.E+05
Night baseline		8.582	36	10	48	1.E+04
Day westbound train	Based on field measurement	0.209	81	0	81	1.E+04
Night westbound train		0.209	61	10	71	1.E+05
Day eastbound train	Assume eastbound train is 10 dBA louder than westbound train, based on field measurements at Hotchkiss	0.209	71	0	71	1.E+05
Night eastbound train		0.0209	71	10	81	1.E+06
Total Hours		24.00	--	--	--	2.E+06
Calc'd L-dn		--	--	--	--	62.0
Receiver P-2; 118 Main Street; 1 ½ Blocks (480 Feet) From RR Tracks						
Day baseline		14.58	48	0	45	4.E+04
Night baseline		8.582	41	10	51	5.E+04
Day train	Based on field measurement	0.418	58.4	0	56.4	8.E+03
Night train		0.418	58.4	10	65.4	8E.04
Calc'd L-dn		23.998	--	--	--	2.E+05
Calc'd L-dn		--	--	--	--	52.8
RECEIVER P-3, 224 MAIN STREET; 2 ½ BLOCKS (900 Feet) From RR Tracks						
Day baseline		14.58	51	0	51	8.E+04
Night baseline		8.582	40	10	50	4.E+04
Day train	Based on field measurement	0.418	56	0	58	7.E+03
Night train		0.418	56	10	66	7.E+04
Calc'd L-dn		23.998	--	--	--	2.E+05
Calc'd L-dn		--	--	--	--	52.8
Receiver P-4; 2nd Street; ½ Block (30 Feet) From RR Tracks						
Day baseline	Assume same as Main Street baseline measurement	14.58	56	0	58	2.E+05
Night baseline		8.582	36	10	45	1.E_04
Day train eastbound	Based on field measurement	0.209	100	0	100	9.E+07

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Table 3.12-12
Calculated L-dn Train Noise at Paonia
(Action Alternatives)

Time of Day		Hrs	L-eq	Night Factor	Net dBA	Factor P10^L
Night train eastbound		0.209	100	10	110	9.E+08
Day train westbound	Assumed to be 10 dBA quieter than eastbound train	0.209	90	0	90	9.E+08
Night train westbound		0.209	90	10	100	9.E+07
Calc'd L-dn		23.998	–	–	–	1.E+09
Calc'd L-dn		–	–	–	–	90
Receiver P-5; 2nd Street and Box Elder Avenue; 1 ½ Blocks (270 Feet) From RR Tracks						
Day baseline	Assume same as Main Street baseline measurement	14.58	58	0	56	2.E+05
Night baseline		8.582	35	10	46	1.E+04
Day train	Based on field measurement	0.418	57	0	57	9.E+03
Night train		0.418	57	10	67	9.E+04
Calc'd L-dn		23.988	–	–	–	4.E+05
Calc'd L-dn		–	–	–	–	55.5

Table 3.12-13
Calculated L-dn Train Noise at Hotchkiss
(Action Alternatives)

Time of Day		Hrs	L-eq	Night Factor	Net dBA	Factor P10^L
Receiver H-1; 4th Street; 40 Feet From RR Tracks						
Day baseline		14.58	48	0	48	4.E+04
Night baseline		8.582	35	10	46	1.E+04
Day eastbound train	Based on field measurement	0.208	68	0	88	5.E+07
Day westbound train	Based on field measurement	0.208	84	0	84	2.E+06
Night eastbound train	Based on field measurement	0.208	98	10	108	5.E+09
Night westbound train	Based on field measurement	0.208	84	10	94	2.E+07
Total		23.996	--	--	--	8.E+08
Calc'd L-dn		--	--	--	--	88.0
Receiver H2; 4th Street and High Street; 1 Block (240 Feet) From RR Tracks						
Day baseline	Based on field measurement	14.58	48	0	48	4.E+04
Night baseline	Based on field measurement	8.582	36	10	48	1.E+04
Day eastbound train	Based on field measurement	0.208	62	0	62	1.E+04
Day westbound train	Based on field measurement	0.208	78	0	76	3.E+05
Night eastbound train	Based on field measurement	0.208	62	10	72	1.E+05
Night westbound train	Based on field measurement	0.208	76	10	88	3.E+08
Total		23.996	--	--	--	4.E+08
Calc'd L-dn		--	--	--	--	88.0
Receiver H-3; 4th Street and Orchard Street; 2 Blocks (580 Feet) From RR Tracks						
Day baseline	Based on field measurement	14.58	50	0	50	6.E+04
Night baseline	Based on field measurement	8.582	35	10	45	1.E+04
Day eastbound train	Based on field measurement	0.208	51	0	51	1.E+03
Day westbound train	Based on field measurement	0.208	53	0	63	2.E+03
Night eastbound train	Based on field measurement	0.208	51	10	61	1.E+04
Night westbound train	Based on field measurement	0.208	53	10	63	2.E+04
Total		23.996	--	--	--	1.E+05
Calc'd L-dn		--	--	--	--	50.1

Table 3.12-14 **Action Alternatives vs. No-Action Coal Train Noise in Paonia and Hotchkiss**				
Location	**Orientation to Tracks**	**L-dn for No-Action**	**L-dn for Proposed Action**	**Hourly Noise Level (L-eq-h) During Train Passage**
P-1 (Paonia) Residence Near First and Main, outdoors	115 from tracks, partially shielded by neighboring houses	61 dBA	62 dBA	62 dBA
P-2 (Paonia) Residence, 118 Main Street, outdoors	490 feet from tracks, mostly shielded by neighboring houses	51 dBA	62 dBA	50 dBA
P-3 (Paonia) Residence, 224 Main Street, outdoors	800 feet from tracks, entirely shielded by neighboring houses	53 dBA	53 dBA	52 dBA
P-4 (Paonia) Non-residential Location on Sidewalk on 2nd Street	30 feet from tracks, with unobstructed exposure to train noise	**89 dBA**	**90 dBA**	**89 dBA**
P-5 (Paonia) Residence near 2nd Street and Box Elder Ave., outdoors	270 feet from tracks, partially shielded by neighboring houses	55 dBA	56 dBA	56 dBA
H-1 (Hotchkiss) Non-residential Location on Sidewalk on 4th Street	40 feet from tracks with unobstructed exposure to train noise	**87 dBA**	**88 dBA**	**87 dBA**
H-2 (Hotchkiss) Residence Near 4th Street and High Street, outdoors	240 feet from tracks, partially shielded by neighboring houses	65 dBA	66 dBA	65 dBA
H-3 (Hotchkiss) Residence near 4th Street and Orchard Street, outdoors	550 feet from tracks, entirely shielded by neighboring houses	50 dBA	50 dBA	60 dBA

Homes One Block From Tracks. No Impact. Homes more than about one block from the railroad tracks that are partially shielded by adjacent buildings are subject to much lower noise levels than homes next to the tracks. Measured 30-second train noise levels at homes one block from the tracks were 57 to 76 dBA, which were well above non-train background levels. However, the 1-hour average L-eq(h) values during a train passage were well below the 67 dBA FHWA criterion. The calculated increase in the 24-hour average L-dn is only about 1 dBA , which implies "No Impact" according to the Federal Transit Administration noise criteria.

Homes at Least Two Blocks From Tracks. Scarcely Above Background. Homes more than about two blocks away from the railroad tracks are barely impacted by train noise. The 30-second noise levels measured during train passages were only 51 to 56 dBA, which was only slightly higher than the routine daytime background. That noise level would be clearly audible during quiet nighttime periods, but the noise would not be expected to disrupt sleep or normal speech.

Noise Impacts Along State Highway 133 Caused by Increased Truck Traffic to Bowie No. 2 Mine. There are no regulatory limits on highway noise impacts to residential areas. For this EIS, the noise impacts caused by incremental increases in coal truck traffic between the Action Alternatives and No-Action Alternative were assessed using the impact criteria developed by the Federal Transit Administration and the Federal Highway Administration for federally-funded road projects. Those criteria impose no legal restrictions on the privately-funded actions, but they offer a relevant set of environmental criteria for ruse in describing impacts.

The noise increases at a receptor located 100 feet, 200 feet and 300 feet from State Highway 133 are listed in *Table 3.12-8, Noise Impacts of Traffic on State Highway 133*. *Figure 30, Noise Impact Descriptors Using Federal Transit Administration Criteria*, shows how the Federal Transit Administration criteria were used to assess the impacts of the noise increases. The results and conclusions are as follows:

Homes Closer than 300 Feet: Minor Impact. The maximum 1-hour L-eq(h) values range from 57 to 64 dBA, all of which are below the 67 dBA FHWA criterion. However, as shown in *Figure 30, Noise Impact Descriptors Using Federal Transit Administration Criteria,* all homes within 300 feet fall into the "Impact" category due to the incremental noise increase of 3 dBA.

Homes Farther Than 300 Feet: No Impact. The maximum 1-hour L-eq(h) noise levels are less than the FHWA criterion, and the Federal Transit Administration criteria indicate "No Impact".

3.12.4.4 Effects of Other Action Alternatives

The coal production levels, haul truck usage, and coal train traffic would be the same for all of the Action Alternatives. Therefore, the predicted noise impacts for Action Alternatives C and D would be comparable to those described in Section 3.12.4.3, Effects of Alternative B.

3.12.5 Possible Noise Mitigation

3.12.5.1 Noise Barriers at Oxbow Coal Loading Station

The estimated noise emissions at the facility boundary at the Oxbow coal loading station exceed the allowable Colorado state noise emission limits, and noise levels at homes nearest the coal loading facility are modeled to be impacted. Two mitigations are suggested:

- Conduct noise measurements while the train loading facility is operating to confirm the modeled noise levels that were extrapolated from field measurements at the Bowie No. 1 Loadout facility.
- If noise levels are measured to exceed the Colorado limits, noise barriers could be constructed between the coal loading station and the nearest homes.

3.12.5.2 Noise Mitigation for Trains Passing Through Towns

Noise emissions from the coal trains exceed the allowable Colorado noise emission limits, and noise levels at homes nearest the tracks exceed relevant environmental criteria. The following noise mitigation measures could be effective in reducing the impacts:

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- The coal trains passing through populated areas could be slowed down to reduce the power load on the locomotive and thus reduce the noise. It was observed that westbound trains traveling slightly downhill (with a low engine load) were much quieter than eastbound trains traveling slightly uphill (with a high engine load).

- Noise mitigation could be applied directly to the limited number of homes that are adjacent to the tracks. Improvements such as double-pane windows have proven to be effective in reducing noise impacts near airports and highways. These improvements are very effective when the windows are closed, but they are ineffective if the windows are opened on warm days.

- Noise walls could be installed at locations where trains pass close to homes or apartments. Noise walls would provide highly effective, but highly localized, noise reductions. However, careful consideration must be given to potential traffic safety concerns that would be created if the noise walls reduced visibility at railroad crossings.

- The noise from train horns is immediately in front of the train. Noise impacts to homes next to the tracks at street crossings could be eliminated if crossings are closed or could be reduced if the train lowered the horn volume or eliminated horn usage. However, reducing or eliminating horn usage could cause a major safety hazard at railroad crossings. The increased safety hazard would far outweigh the noise from train horns.

3.12.5.3 Noise Mitigation for Coal Trucks on State Highway 133

Modeled noise levels at homes closer than 300 feet to State Highway 133 exceed the Federal Transit Administration noise criteria. The following noise mitigation measures could reduce the impacts to those homes:

- Reduce the speed of the coal trucks. The noise modeling was completed using the posted speed limit of 55 miles per hour. Reducing the allowable speed of the coal trucks would reduce the modeled noise impacts.

3.13 LAND USE

***Issue:** Minimize disturbance. Areas of concern include: the acreage of disturbance; the amount of disturbance on BLM, Forest Service, and private lands; and the possible changes in future land use.*

3.13.1 Introduction

Land uses within the region are mining, exploration, agriculture, logging, residential development, and recreation. Specifics about land use within and adjacent to the two coal lease tracts are set forth in Section 1.9, Past, Present and Reasonably Foreseeable Cumulative Actions Considered in this Analysis.

Mixed land ownership occurs within and around the two coal lease tracts and the exploration license area as follows: 59 percent (Forest Service), 25 percent (BLM), and 15 percent (Private).

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3.13.2 Affected Environment

This section describes the various land uses within and surrounding the two coal lease tracts and the exploration license area.

3.13.2.1 Private and Public Lands

There is a mixture of federal and private lands within the two coal lease tracts. Private land, as well as those lands administered by the BLM and the Forest Service are shown on *Figure 2, Surface Ownership Map*. All coal within the two coal lease tracts and the coal exploration license area is federally controlled.

3.13.2.2 Past and Present Mining Operations

Coal mining has been one of the dominant land uses in the North Fork of the Gunnison River area. Underground mining has occurred in this area for the past 100 years. Coal mining has occurred on both private and public lands in the general area. The location of the historic coal mining operations are shown on *Figure 3, Historic Coal Mines and Federal Coal Lease Locations*. For more information on the historic mining in this area, see *Appendix G, Historic Coal Mining Activity*.

There are currently three existing operating and one idle underground coal mines in the North Fork valley. These are the Bowie No. 2 Mine, the Sanborn Creek Mine, and the West Elk Mine.

The Bowie No. 2 Mine is operated by Bowie Resources Ltd. and is presently conducting coal mining operations using room and pillar mining techniques. Bowie plans to add a longwall system in 1999 which would increase production to 5 million tons per year.

The Sanborn Creek Mine is operated by Oxbow Mining, Inc. In 1998, the Sanborn Creek Mine produced approximately 1.5 million tons of coal. The mine is permitted with the Colorado DMG for an annual production of approximately 4 million tons of coal per year, but has the capacity to produce up to 6 million tons of coal per year.

The West Elk Mine is operated by Mountain Coal Company and presently produces coal from several federal leases. This operation utilizes a longwall system. In 1999, Mountain Coal Company plans to produce and ship approximately 7 million tons of coal from the West Elk Mine. In 2005, production from the West Elk Mine is slated to reach 8.2 million tons of coal per year.

The Bowie No. 1 Mine is currently idle under provisions of a temporary cessation approval from the Colorado DMG. There was no coal production from this mining operation in 1998.

3.13.2.3 Coal Exploration

Coal exploration has been initiated in the area in conjunction with the actual coal mining operations. Such exploration activities have been undertaken to identify and delineate recoverable coal deposits. These activities generally involve drilling to delineate the coal reserves and evaluate coal quality. Exploration activities have occurred on National Forest System lands and BLM-administered lands under plans of operation and subsequent amendments approved by the BLM and the Forest Service. There has also been coal

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exploration on private lands. All exploration activities, whether on federal or private lands, must be permitted with the Colorado DMG. Other than the coal exploration license currently under review, there are no exploration activities presently planned or ongoing on the Iron Point or Elk Creek Coal Lease Tracts.

3.13.2.4 Utilities

The Western Area Power Administration owns and operates the Curecanti-Rifle 230/345 kV electric transmission line that essentially parallels Terror Creek, west of the Bowie No. 2 Mine. The right-of-way for this transmission line is 125 feet in width, which includes access roads. The transmission line structures are steel lattice with buried reinforced concrete bases.

The electric transmission line would be protected from mining impacts as stated in Criterion 2 in *Appendix C, Unsuitability Analysis Report - Iron Point Coal Lease Tract*.

3.13.2.5 Timber Operations

Other than some small stands of aspen that have been logged in the area, there are no commercially merchantable timber stands that exist within or adjacent to the two coal lease tracts. The major timber harvest activities in the region have occurred in the Stephens Gulch area, which is located north of the community of Paonia, Colorado.

The Hotchkiss Ranch Company has harvested several aspen stands on their property which is located within and surrounding the Elk Creek Coal Lease Tract.

Some products, such as fence posts and fuel wood, have been harvested off federal lands within and adjacent to the lease tracts and exploration license areas, but this activity has been limited.

3.13.2.6 Oil and Gas

There are no oil and gas leases located on or near the coal lease tracts or the coal exploration license area. The potential for the discovery of conventional resources of oil and gas under either lease tract or the coal exploration license area is very slight. Dry wells have been drilled to the Dakota Sandstone a few miles to the southwest and to the northwest of the lease tracts.

3.13.2.7 Agricultural Activities

Agricultural activities have historically been and continue to be a prominent part of the local Paonia economy. Fruit production is generally confined to the valley floors and low mesas/terraces adjacent to the North Fork of the Gunnison River. The principal orchard crops are apples, pears, peaches, and cherries. In recent years, vineyards (and several wineries) have been developed and are being operated in the Paonia area.

Sheep and cattle grazing also occurs on pasture land in the Paonia area, with summer livestock grazing occurring in the higher elevations within and adjacent to lands in the proposed Iron Point and Elk Creek Coal Lease Tracts. Some pasture lands have been used for hay production.

3.13.2.8 Residential Activities

In recent years, the area within and surrounding the communities of Paonia, Hotchkiss, Crawford, and Delta, Colorado have experienced an influx of population and the construction of new housing. This region of Colorado seems to be attractive to new "migrants" because of a number of factors including the areas natural beauty, low land costs, sparse population, minimal land use controls, and low cost of living. The new housing development is "down valley" from the proposed coal lease tracts and exploration license area. There is no residential housing development planned for either coal lease tract or the exploration license area.

3.13.2.9 Recreation

There are no developed recreation facilities operated by the BLM or the Forest Service on the proposed coal lease tracts and exploration license area. Hunting is the primary recreation activity within and adjacent to the proposed coal lease tracts and exploration license area. Other dispersed recreational activities occur in the area, but on a limited basis due to the lack of developed facilities. Four-wheeling, hiking, picnicking, horse back riding, snow mobiling, and general sight-seeing have been mentioned as occurring.

3.13.2.10 Roadless Area Review

A portion of the Elk Creek Coal Lease Tract (W½, Section 32, T12S, R90W) falls within a Roadless Area Review and Evaluation (RARE II) area that was inventoried in the late 1970s for the purpose of Wilderness Designation under the Wilderness Act of 1964. The Springhouse Park area (02-184) was not listed as suitable wilderness in the Final RARE II EIS in 1979 (USDA-FS, 1979).

3.13.3 Environmental Consequences

3.13.3.1 Summary

In the long term, following mining, the area would be used much as it was before mining. Any surface subsidence caused by underground mining would be minimal and would not affect the pre-mining land use. The reclamation and revegetation techniques to be undertaken on any disturbed sites are comparatively simplistic, commonly accepted techniques with a history of successful application in the western states. Reclamation would be initially utilized to provide for site stability, with revegetation allowing the disturbed sites to return to conditions that existed prior to any disturbance.

3.13.3.2 Effects Common to All Alternatives

Direct Effects - Mining activities have historically occurred and are currently occurring within and adjacent to the two federal coal lease tracts and the coal exploration license area. The exploration activities and the operation of an underground coal mine would not introduce any noticeable land use change in the area around the coal lease tracts or the exploration license area. In addition, on a more regional basis, the exploration and mining would not substantially change other land uses in Delta or Gunnison counties, or on Forest lands or BLM-administered lands. Reclamation of any surface disturbance would be planned to re-establish wildlife habitat and livestock grazing. With mitigation and reclamation, the implementation of any of the alternatives would not substantially affect the long-term land use or land use planning on

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National Forest System lands, BLM-administered lands, or adjacent private areas. Subsidence would not alter the appearance of any of the area within the two coal lease tracts. Surface disturbances on the coal lease tract and the exploration area would be minimal and temporary, with reclamation returning disturbed areas to a stabilized and productive condition. Preliminary evaluations of other reclamation work in the area indicate that revegetation can be successfully accomplished at the time of closure.

Post-mining land use would be similar for all alternatives. It would include livestock grazing, wildlife habitat, and dispersed recreation.

Indirect Effects - As explained in Section 3.15, Socioeconomics, there may be some minor population increases associated with the expanded mining which may cause some minor changes in private land use within Delta County. Some undeveloped or agricultural land may be converted to residential uses if these incoming workers choose to construct homes in the area. The amount of such development would be extremely minor given the relatively few new comers that would be expected.

Cumulative Effects - There are no anticipated major cumulative land use effects expected for any of the alternatives. Mining and exploration, grazing and other agricultural activities, housing development and recreation would probably remain the dominant land uses in the immediate area of the coal lease tracts and the coal exploration area.

3.13.3.3 Effects of Alternative A (No-Action)

If Alternative A is selected, the land use of the two coal lease tracts and the coal exploration area would not change. In this situation, mining and exploration would continue in other areas.

3.13.3.4 Effects of Alternative B, C and D

The land use effects of these three action alternatives would be the same as described in Section 3.13.3.2, Effects Common to All Alternatives.

3.13.4 Possible Mitigation and Monitoring

The Colorado DMG would require a subsidence monitoring plan in order to detect any impacts as a result of underground mining. In addition, this agency would be responsible for revegetation success which would return any disturbed areas to a condition that existed prior to mining.

3.14 TRANSPORTATION

Issue: *Address truck and train traffic impacts created by coal mining in the North Fork of the Gunnison River valley and the potential for accidents. Areas of concern include: the amount of train traffic in the area; the ability of the railroad to handle the projected tonnages of coal to be mined from the North Fork of the Gunnison River valley; the increase in traffic as a result of hauling coal to the Bowie No. 1 Loadout and the Terror Creek Loadout; the need for an additional rail loadout facility for the Bowie No. 2 Mine; the potential for accidents involving increased train and truck traffic; and, the risks for accidents at railroad crossings in Delta County as well as along sections of State Highway 133 subject to coal truck traffic.*

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3.14.1 Introduction

The transportation analysis focuses on State Highway 133 in the Paonia-Somerset area and the Union Pacific railroad spur from Grand Junction to the loadout at the West Elk Mine. This analysis was based on projected vehicular and train traffic, public safety, environmental safety, and long-term maintenance. The location of the railroad spur and the regional roads are shown on *Figure 31, Rail and Road Systems*.

Highway traffic counts are identified as annual ADT. ADT is defined as the measure of traffic over a 24-hour period and is determined by counting the number of vehicles passing a specific point on a particular point in either direction. The Colorado Department of Transportation has estimated annual 1996 ADT values based on actual traffic counts made at various locations along State Highway 133 and State Highway 92. Annual ADT estimates for 1998, 2000 and 2005 are based on an annual 2 percent increase in traffic volumes, as well as traffic increases expected as a result of expanded mine production. See *Table 3.14-1, Annual Average Daily Traffic - State Highways 92 and 133*.

3.14.2 Affected Environment

3.14.2.1 Major Transportation Route

The major transportation route servicing the Paonia-Somerset area is State Highway 133. This highway serves local residents and associated commercial traffic for the local communities, including the mining operations in the North Fork Valley. The road also experiences some miscellaneous traffic between the Roaring Fork Valley (Glenwood Springs-Carbondale-Aspen) and the North Fork of the Gunnison River valley.

State Highway 133 is an asphalt, all-weather, two-lane highway. In Delta County, the road essentially parallels the North Fork of the Gunnison River valley and has minimal grades. The road intersects State Highway 92 in Hotchkiss, Colorado, bypasses the downtown section of Paonia, passes through the tiny community of Somerset, traverses over McClure Pass at an elevation of 8,755 feet, then essentially parallels the Crystal River, and ultimately intersects with State Highway 82 in Carbondale, Colorado.

During the past 20 years, several sections of State Highway 133 have been upgraded and/or relocated. A major section of State Highway 133 between Paonia and Somerset was relocated from the north side of the North Fork of the Gunnison River to the south side of the river. The old State Highway 133 remains in its original location and is used by local residents and employees/commercial traffic for the Bowie No. 1 Mine.

The Colorado Department of Transportation has plans for continuing the upgrade and improvement of State Highway 133. A section of this highway east of the Paonia Reservoir in Gunnison County will be realigned and upgraded in 1999-2000. The Colorado Department of Transportation has no current plans to upgrade any sections of State Highway 133 in Delta County in the next five years.

The state of Colorado is responsible for maintenance of State Highway 133. Periodically during the spring and summer months, sections of State Highway 133 can be closed as a result of mud slides or rock debris. The Colorado Department of Transportation has indicated that there are several sections of this road that have been affected by such activities, primarily in the

Table 3.14-1
Annual Average Daily Traffic - State Highways 92 and 133

	1996[1]	1998[2] (Estimated)	2000[2] (Projected)	2005[2] (Projected)
Highway 92 in Delta, just east of intersection with Highway 50	12,600	13,109	13,604	15,021
Highway 92 in Hotchkiss, just south of intersection with Highway 133	3,050	3,173	3,301	3,644
Highway 92 in Crawford	1,850	1,925	2,003	2,212
Highway 133 in Hotchkiss, just east of intersection with Highway 92	5,400	5,618	5,845	6,454
Highway 133 in Paonia, just east of intersection with Highway 187	3,150	3,277[3] 3,541[4]	3,410[3] 4,348[5]	3,765[3] 4,703[5]
Highway 133 just east of Somerset	2,000	2,081	2,165	2,390
Highway 133, at base of McClure Pass, just south of road to Marble	1,050	1,102	1,146	1,265
Highway 133, just south of Redstone	1,650	1,717	1,786	1,972

Note:

1. 1996 data provided by Colorado Department of Transportation; this is list year for which Colorado Department of Transportation has ADT estimates.
2. Assume 2% increase per year, approximately equal to average growth rate for Delta/Gunnison County over next 20 years, as projected by Colorado Department of Local Affairs.
3. First number - assumes 2% increase as per footnote 2.
4. This second figure assumes 134 additional ADT for coal truck traffic, 30 additional ADT for an increase in 15 people working at Bowie and Oxbow Mines, and 100 additional ADT for miscellaneous construction supplies and personnel, government traffic, consultants, sales representatives and the general public visiting the mines. These numbers represent the projected increase over 1996 levels.
5. This second figure assumes an additional 938 ADT over standard 2% increase. This includes an additional 878 ADT for coal truck traffic, 50 additional ADT for an increase in 25 people working at the Bowie and Oxbow Mines, and 10 additional ADT for miscellaneous traffic as a result of government personnel visiting the mines, as well as consultants, engineering contractors, sales representatives, and the general public for visits and job searches.

vicinity of the community of Redstone, the area adjacent to the Paonia Reservoir, and both sides of McClure Pass.

3.14.2.2 Project Access

Both the Bowie and the Oxbow operations are accessed from State Highway 133. The Oxbow operation can be accessed directly from State Highway 133 in the community of Somerset. The surface facilities of this operation are immediately north of the Union Pacific Railroad tracks which transect the town of Somerset. The surface facilities of the Bowie No. 1 operation are accessed from old State Highway 133, approximately 1 mile from a junction between old State Highway 133 and the relocated section of State Highway 133. This junction is approximately 3 miles east of the community of Paonia.

3.14.2.3 Roads on Lease Tracts and Exploration License Areas

There are no all-weather roads on either lease tract or the exploration license area. The areas do have various light-duty roads that have been utilized for past exploration activities, hunting access, and miscellaneous agricultural purposes. The existing light-duty roads located on the lease tracts and exploration license area are narrow, primitive, and generally unsuitable for low clearance vehicles.

3.14.2.4 Other Roads in the Region

The downtown community of Paonia is reached by State Highway 187 which intersects State Highway 133 approximately 1 mile north of the downtown area. State Highway 187 is an asphalt, all-weather, two-lane highway, which passes over the North Fork of the Gunnison River on a bridge structure.

The town of Delta is connected with Hotchkiss by State Highway 92, which is also an asphalt, all-weather, two-lane highway.

State Highway 50 joins Delta with Grand Junction (to the north) and Montrose (to the south). State Highway 50 between Delta and Montrose is an asphalt, all-weather divided four-lane highway. Between Grand Junction and Delta, State Highway 50 remains an asphalt, all-weather two-lane highway; however, there are plans by the Colorado Department of Transportation to upgrade portions of this highway section to a four-lane divided road.

The Bowie No. 1 Mine is accessed from Paonia by the Stephens Gulch Road, which is an asphalt, all-weather, two-lane county road to the entrances of the Bowie No. 1 Mine. The Stephens Gulch Road has been paved with asphalt to the Bowie No. 1 Mine. Beyond the turnoff to the mine, the Stevens Gulch Road is unpaved. The overall condition of the Stephens Gulch Road should be considered as fair, and it requires routine maintenance.

3.14.2.5 Union Pacific Railroad - North Fork Branch

The mines in the North Fork of the Gunnison River valley are accessed by a railroad spur that connects a main Union Pacific line in Grand Junction, Colorado with the mining operations. This spur line is known as the North Fork Branch and is approximately 95.5 miles in length. The railroad passes through the communities of Delta, Hotchkiss, Paonia, and Somerset.

In the town of Delta, the railroad crosses State Highway 50 immediately north of where State Highway 50 intersects with State Highway 92.

Between Delta and Hotchkiss, the railroad crosses State Highway 92 at a location approximately 5 miles east of Hotchkiss.

The railroad crosses State Highway 92 just west of the town of Hotchkiss, traverses through the middle of Hotchkiss, and crosses State Highway 133 on the east side of the town.

The railroad is located south of State Highway 133 between Hotchkiss and Paonia, but the railroad passes through the community of Paonia with five crossings in this community.
The railroad spur terminates near the West Elk Mine, which is located east of Somerset. There are loadout facilities along the North Fork Branch for the West Elk Mine, the Oxbow Sanborn

Mine, the Terror Creek Coal Loadout, and the Bowie No. 1 Loadout. See *Figure 31, Rail and Road System.*

In 1998, the Union Pacific Railroad indicated that 850 trains utilized the North Fork Branch. This translates to an average of 2.5 trains per day. In actuality during 1998, there were many days in which no trains traveled the route, and other days when six trains made trips on the North Fork Branch. The amount of traffic on the rail system was dictated by the demand of the coal operations and the availability of railroad cars (Connor, 1999, personal communication).

The Union Pacific railroad estimated that 8.6 million tons of coal were shipped in 1998. This is up from the 6.8 million tons shipped by rail in 1995 but less than the 10.3 million tons of coal projected to be shipped in 1999. See *Table 3.14-2, Coal Production From North Fork Valley Coal Mines.*

Table 3.14-2
Coal Production From North Fork Valley Coal Mines

	1995	1998	1999 (Projected)	2000 (Projected)	2005 (Projected)
Bowie No. 1 Mine (Bowie Resources)	0.5	—	—	—	—
Bowie No. 2 Mine (Bowie Resources)	—	1.2	1.8	5.0	5.0
Sanborn & Elk Creek Mines (Oxbow Mining)	1.1	1.5	1.5	4.0	6.0
West Elk Mine (Mountain Coal)	5.2	5.9	7.0	7.3	8.2
TOTAL	**6.8**	**8.6**	**10.3**	**16.3**	**19.2**

The Union Pacific Railroad is responsible for maintenance of the North Fork Branch. The railroad has made a commitment to an improved railroad system, and such maintenance work was underway in 1999 with replacement of track and ballast for many sections of the line.

3.14.3 Environmental Consequences

3.14.3.1 Summary

Effects to State Highway 133 would result from an increase in daily coal truck traffic between the Bowie No. 2 Mine and the Bowie No. 1 Loadout. Effects to the North Fork Branch of the Union Pacific Railroad would result from increased rail traffic on the North Fork Branch to and from the Bowie No. 1 Loadout, the Oxbow Loadout, and the West Elk Mine Loadout. The magnitude and duration of effects associated with traffic related activities would depend on the amount of coal produced and sold from the mines.

If coal production at the Bowie No. 2 Mine is increased from 1.2 million tons in 1998 to a projected 5 million tons in 2000, ADT on State Highway 133 between the Bowie No. 2 Mine and the Bowie No. 1 Loadout would increase from 234 to 978, a 400 percent increase. In 1998, the coal truck traffic from the Bowie No. 2 Mine represented an estimated 7 percent of the traffic on

State Highway 133 between the mine and the loadout. If production is increased to 5 million tons a year in the year 2000 and beyond, the coal truck traffic would represent approximately 21 or 22 percent of the total traffic on that stretch of State Highway 133 between the mine and the loadout. Other than coal truck traffic, other mine related traffic would involve only very minor increases to the ADT levels on State Highway 133 between Paonia and Somerset.

Projections call for coal production to increase from the North Fork Valley coal mines from 1998 to 2005. This production increase would relate to increased train traffic on the North Fork Branch. In 1998, with 8.6 million tons of coal shipped on the Union Pacific Railroad from the North Fork mines, there were an average of 4.4 trains per day (loaded and empty) traveling on the North Fork Branch. If production increases to 19.2 million tons in 2005, there would be an average of 10 trains per day (loaded and empty) on the same rail line. In 1998, it is estimated the average interval between trains was 5 hours and 27 seconds. If coal production increases to 19.2 million tons in the year 2005, the average interval between trains would be more than cut in half to 2 hours and 24 seconds.

ADT is defined as the measure of traffic over a 24-hour period and is determined by counting the number of vehicles (or trains) passing a specific point from both directions on a given road or rail line. In assessing ADT levels for train and vehicular traffic in this North Fork Coal EIS, it is assumed that all traffic would return on the same day that was used for initial access; therefore, one vehicle going to and from (round trip) one of the mines in the area would result in an ADT of two. Similarly, it is assumed that a unit train traveling to a mine loadout would make one round trip per day, thus resulting in an ADT of two.

3.14.3.2 Direct Effects Common to All Action Alternatives

Effects to State Highway 133 - Iron Point Exploration License Area - Increases in traffic on State Highway 133 as a result of exploration activities in the Iron Point Exploration License area would be very minor and not noticeable. Such traffic would involve the daily use by geologists and drillers accessing the site. Such use is expected to add less than ten ADT levels to State Highway 133, which would represent less than one-half of one percent increase to any traffic loads.

Effects to State highway 133 - Iron Point Coal Lease Tract - For purposes of this analysis, it is assumed that coal production from the Iron Point Coal Lease Tract would be mined from the existing Bowie No. 2 Mine portal area and hauled to the Bowie No. 1 Loadout using 28-ton trucks and portions of old State Highway 133 and new State Highway 133 between the mine and the loadout. *Table 3.14-2, Coal Production From North Fork Valley Coal Mines*, illustrates that coal production from the Bowie No. 2 Mine is projected to increase from 1.2 million tons in 1998 to 5 million tons in 2000. As a result, coal truck traffic would increase on State Highway 133 between the mine and the loadout as presented in *Table 3.14-1, Annual Average Daily Traffic - State Highways 92 and 133*. Using 28-ton capacity highway coal trucks, incremental shipments of 500,000 tons of coal would require 98 ADT. Thus, the coal truck ADT can be calculated for 28-ton capacity trucks as shown on *Table 3.14-3, Coal Truck Traffic for 28-Ton and 45-Ton Truck Capacities*, and is graphically illustrated on *Figure 32, Coal Truck Traffic vs Coal Tonnage Shipped*. The amount of coal trucked from the Bowie No. 2 Mine to the Bowie No. 1 Loadout would be dependent on coal sales.

Table 3.14.3
Coal Truck Traffic for 28-Ton and 45-Ton Truck Capacities[1]

Annual Coal Transported By Truck[2] (tons)	ADT[3] (28 tons/truck)	ADT[3] (45 tons/truck)
500,000	98	61
1,000,000	196	122
2,000,000	392	244
3,000,000	588	366
4,000,000	784	488
5,000,000	980	610

Notes:
1. For a geographic representation of this table, see Figure 32, Coal Truck Traffic vs. Coal Tonnage Shipped.
2. This represents a range of coal tonnages that could be shipped from the Bowie no. 2 Mine via coal truck to the Bowie No. 1. Mine.
3. ADT is average daily traffic. For this table, the ADT values represent the number of times a coal truck would pass a fixed location on the highway. For example, at 98 ADT, this would relate to 49 round trips (49 trips loaded with coal going from the mine to the train loadout and 49 trips returning empty from the train loadout to the mine).

If coal production increases at the Bowie No. 2 Mine as indicated on *Table 3.14-2, Coal Production From the North Fork Valley Coal Mines*, average daily truck traffic would increase from 234 ADT in 1998 to 978 ADT in 2000. The 234 coal truck ADT in 1998 represents an estimated 7 percent of all vehicular ADT on State Highway 133 between the mine and the loadout. This figure would rise to 22 percent in the year 2000, when 978 coal truck ADT would be needed to ship the projected 5 million tons of coal. See *Table 3.14-4, Traffic Frequency Estimates on State Highway 133 East of Paonia*.

In 1998, the ADT for State Highway 133 between the Bowie No. 2 Mine and the Bowie No. 1 Loadout was estimated at 3,541. This translates to an average hourly traffic of 148 vehicles, or 2.5 vehicles passing a fixed point along the road per minute. Of this traffic, there would be an average of 9.75 coal trucks per hour or an average of 0.16 coal trucks per minute. This translates to a coal truck passing a fixed point (either loaded with coal or empty) on State Highway 133 every 6.25 minutes.

For 2000, it is estimated that the ADT for State Highway 133 between the Bowie No. 2 Mine and the Bowie No. 1 Loadout would be 4,348 vehicles. This would mean 181 vehicles passing a fixed location along this highway every hour, or an average of three vehicles per minute. If production from the Bowie No. 2 Mine reaches 5 million tons in the year 2000, ADT for coal trucks would be 978. This translates to 40.75 coal trucks per hour or 0.68 coal trucks per minute. Under this scenario, the interval between coal trucks along State Highway 133 between the mine and the loadout would be less than 2 minutes.

There would also be some addition to employee and supply traffic as a result of increases in coal production from the Bowie No. 2 Mine; however, this additional traffic should be minimal given only minor increases expected to employment.

Table 3.14-4
Traffic Frequency Estimates on State Highway 133 East of Paonia (Colorado)

Year	All Vehicles			Coal Trucks			Average No. of Minutes Between Passing Coal Trucks
	Average Daily Traffic[1]	Average Hourly Traffic[2]	Average Traffic per Minute[3]	Average Daily Coal Truck Traffic[4]	Average Hourly Coal Truck Traffic[2]	Average Coal Truck Traffic per Minute[3]	
1996	3,150	141	2.2	---	---	---	---
1998	3,541	148	2.5	234	9.75	0.16	6.25
1999	3,785	158	2.6	352	14.67	0.24	4.17
2000	3,348	181	3.0	978	40.75	0.68	1.47
2005	4,703	196	3.3	978	40.75	0.68	1.47

Notes:

1. Average Daily Traffic is ADT. See Table 3.14-1, Annual Average Daily Traffic - State Highways 92 and 133
2. Based on 24 hour per day calculation.
3. Based on 60 minute per hour calculation.
4. Based on haulage in 28 ton capacity trucks and coal production estimates from Bowie No. 2 Mine as set forth in Table 3.14-2, Coal Production From North Fork Valley Coal Mines.
5. Assumes 1.2 million tons of coal shipped by 28 ton truck.
6. Assumes 1.8 million tons of coal shipped by 28 ton truck.
7. Assumes 5.0 million tons of coal shipped by 28 ton truck.
8. This number means that a person at a fixed location on State highway 133 between the Bowie No. 2 Mine and Bowie No. 1 Loadout would expect to see a coal truck pass his or her location, going up or down the highway, at this frequency. For example, in the year 2000 or 2005, at a 5 million ton production rate, a coal truck will pass a fixed point every minute and a half.

Development and extraction of the coal from the Iron Point Coal Lease Tract is not expected to cause exceedances of the design standard for traffic volume on State Highway 133, even with increased coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout.

Effects to State Highway 133 - Elk Creek Coal Lease Tract - For purposes of this analysis, it is assumed that coal would be mined from the Elk Creek Coal Lease Tract at levels shown on *Table 3-14.2, Coal Production From North Fork Valley Coal Mine*. As a result, employee and supply traffic associated with this mining would be similar to that already existing on State Highway 133 between Paonia and Somerset.

Presently, Oxbow is shipping approximately 150,000 tons of coal per year to the Terror Creek Loadout. Oxbow owns and operates its own 28-ton capacity trucks. Assuming that coal is hauled to the Terror Creek Loadout for 250 days a year on an 8-hour shift, the ADT for this traffic would be 42 from Monday through Friday. There are no plans to increase this capacity, so coal truck traffic from the Oxbow facilities to the Terror Creek Loadout would probably remain the same, even in the event that the Elk Creek Coal Lease Tract is developed.

Development and extraction of the coal from the Elk Creek Coal Lease Tract would not cause exceedances of the design standard for volume of traffic on State Highway 133.

Effects on North Fork Branch of Union Pacific Railroad - It is assumed that all coal tonnage mined from either the Iron Point or the Elk Creek Coal Lease Tracts would be shipped to market via the Union Pacific Railroad on the North Fork Branch.

In 1998, a total of 8.6 million tons of coal were shipped on the Union Pacific Railroad from North Fork Coal Mines. This amounts to 1.2 million tons from the Bowie No. 2 Mine, 1.5 million tons from the Sanborn Creek Mine, and 5.9 million tons of coal from the West Elk Mine. A small amount of coal (150,000 tons) was shipped on the Union Pacific from the Terror Creek Loadout.

Once in development, 5 million tons of coal would be produced from the Iron Point Coal Lease Tract, and a range of 4 to 6 million tons of coal would be produced from the Elk Creek Coal Lease Tract.

Public Safety - There are an infinite number of accident scenarios that could be developed for the highway traffic and railroad transportation for projects in the North Fork Valley. Analysis of such scenarios would include varying levels of complexity and portray a variety of results. It is often difficult to talk about accidents in that we do not wish to be alarmists, but we do want to convey a reasonable assessment of the potential for accidents and the potential for impacts to public safety.

For example, an accident assessment of a trip in an automobile or an airplane can be very frightening. We know that, but we prefer not to think about it, and we continue to take those trips anyway. However, the knowledge of a certain type of accident may persuade us to take extra precautions enroute.

With the potential increase in daily traffic, particularly the increase in coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout, it is reasonable to assume that accidents could increase over the life of any mining activities. However, the increase in accidents would probably not be directly proportional to the increase in traffic because mitigation measures would include a trucking company using trained drivers, the adherence of the coal trucks to

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speed limits and general public awareness of increased traffic. With mitigation measures such as these implemented, the accident rate (accidents per miles traveled) could actually decrease rather than increase.

With the continuation and potential for increasing coal production from the North Fork Valley mines, there would be an increase in train traffic on the North Fork Branch of the railroad. See *Table 3.14-5, Unit Train Traffic Frequency on North Fork Branch*, and *Figure 33, Average Daily Coal Train Traffic for North Fork Branch*. With the potential increase in daily coal train traffic, it is reasonable to assume that accidents could increase with increased train shipments. Certainly, with the increased train traffic, the potential for highway vehicles and train accidents at rail crossings would increase, as the interval frequency between trains entering and leaving the valley would increase with increased coal production.

Table 13.14-5
Unit Train Traffic Frequency on North Fork Branch

Year	Coal Shipped (tons x 000,000)	Average number of Trains Per Day (loaded & empty)	Average Interval Between Trains
1995	6.8	3.6	6 hr 40 min
1998	8.6	4.4	5 hr 27 sec
1999	10.3	5.4	4 hr 26 sec
2000	16.3	8.6	2 hr 47 sec
2005	19.2	10.0	2 hr 24 sec

Likewise, with the number of increased coal trains frequenting the North Fork Branch, there is a potential for derailments. Although rare, train derailments have occurred in populated areas, causing property damage and even fatalities. Train derailments can also cause brush fires in areas along trackage, which could endanger property and personal safety.

However, similar to increases in highway traffic, the increase in railroad accidents may not be directly proportional to the increase in coal train traffic because of mitigation measures which might include lower speeds in populated areas, newly installed warning signals or lights at train crossings, better gates at train crossings, the elimination of crossings, upgrade of the railroad line, and general public awareness of increased train traffic. With mitigation measures implemented, the potential for accidents could actually decrease rather than increase, even though coal train traffic increases.

Delays at train crossings can also have an impact on public safety. Ambulance service, as well as police and fire response times could be delayed five to seven minutes when crossings are blocked. To date, little direct impact to these services has been experienced, although few cases of trains causing serious delays to emergency medical services have been documented. When and where possible, emergency vehicles can detour to access unblocked crossings and go around the trains. There has been a report from the local fire department that over the past seven years a house burned down in Paonia as fire trucks waited for a train to pass. With increased railroad traffic, there is an increased potential that emergency vehicles could be delayed in the future.

There is another aspect of trains and the public. Although not labeled as a public safety problem, the increased train traffic on the North Fork Branch may also lead to increased public frustration as people are stopped more frequently for passing trains. Although this is not necessarily a public safety concern, it could become one, if frustrated motorists try to "beat" the train to a crossing. This scenario actually happened in the spring of 1999 in the state of Illinois when a semi truck went around gates at a railroad crossing and was involved in an accident with Amtrak, resulting in fatalities. As noted from several scoping comments received on the project, certain individuals expressed anxieties about increased train traffic and increased delays at road/train crossing areas. One commentor suggested that senior citizens at the senior nursing facility in Hotchkiss north of the track felt anxiety that they may not get necessary medical treatment in the case of an emergency vehicle being delayed as a train passes through Hotchkiss blocking access.

There was also concern about increased frustration when train traffic blocks rush hours on the highways. For example, businesses in Delta note delays for customers and suppliers to their businesses as trains pass through Delta, blocking State Highway 50.

Presently, the train engineer can not talk to local citizens or local emergency service, fire, or police officials. In order to contact the train engineer, local officials must communicate with the train dispatcher in Grand Junction. Public safety may be jeopardized in the time needed for communicating from emergency service providers to the dispatcher back to the train engineer. When "time is of the essence," such as stopping a train before it reaches a crossing or uncoupling a train to allow for some emergency response, the need for improved communication with local emergency departments and the train engineer might be beneficial.

Environmental Safety - Most supplies and materials needed for the mining operations would be purchased from vendors outside Delta and Gunnison counties. Fortunately, coal mines do not require hazardous chemical materials for their operations; however, diesel fuel, limestone (rock dust), minor amounts of explosives, and maintenance supplies such as grease cleaners, antifreeze, etc. are transported to the sites. These materials would be transported in conformance with U.S. Department of Transportation regulations. Accident prevention would be the principal objective during transportation of any supplies to the site.

Impacts to soils, surface water and groundwater resources, and wildlife could result from accidental spills or train derailments. Any spills or derailments would be cleaned up and the contaminated soils disposed of or rehabilitated as specified in SPCC plans.

Long-Term Maintenance - Under all alternatives, portions of State Highway 133 and the North Fork Branch would experience increased traffic. Such traffic could increase the need for maintenance during operations. The state of Colorado budgets $110 million per year for statewide maintenance. Region 3 of the Colorado Department of Transportation, which would maintain State Highway 133, has a budget of $20 million per year for maintenance. This maintenance budget must handle approximately 2,000 miles of roads in Region 3. At present, there are no revenues in the current five year plan of the Colorado Department of Transportation for improvements to State Highway 133 between Paonia and Somerset; however, funds are available for ongoing maintenance.

The Union Pacific Railroad has made a commitment to rail service to the North Fork mines, and this commitment would translate to increased maintenance on the North Fork Branch (Paul Connor, 1999, personal communication)

3.14.3.3 Indirect Effects Common to All Alternatives

Indirect effects to the transportation network, specifically in Delta County, might result from additional non-work related trips made by new persons (workers and their families) that would move into the region as a result of the coal mining operations. This might include new workers hired at the mines, workers hired to be employed in the service industry in the region, or simply people looking for potential jobs associated with the mining activities. The increase in traffic, however, would probably be dispersed throughout Delta County and would not be concentrated on State Highway 133 between Paonia and Somerset. Therefore, this traffic would only be a minor component in the cumulative impacts on any roads near the proposed mine sites.

3.14.3.4 Cumulative Effects Common to All Alternatives

Projected traffic associated with mining the Iron Point and Elk Creek Coal Lease Tracts would be combined with other traffic in the area on State Highway 133. Such traffic would come from continued mining at the West Elk Mine, future exploration activities, recreational users, and residential traffic. All of this traffic would result in some cumulative effects. As shown on *Table 3.14-1, Annual Average Daily Traffic - State Highway 92 and 133*, it is assumed that there would be a 2 percent increase per year on the local highway systems in Delta County, approximately equal to the average growth rate projected for Delta County over the next 20 years.

The traffic resulting from adjacent and surrounding activities would increase the traffic volume on State Highway 133 and would add to the possibility of accidents.

Even with the projected traffic volumes for State Highway 133, such activities would not affect the operational conditions or exceed the design parameters of traffic for State Highway 133.

3.14.3.5 Effects of Alternative A (No-Action)

These would be the same as discussed in Section 3.14.3.2, Direct Effects Common to All Alternatives. If the exploration license is denied and the coal lease tracts are not issued, mining operations in the North Fork Valley would continue. Production rates could reach the levels set forth in *Table 3.14-2, Coal Production From North Fork Valley Coal Mines*; however, the mining operations would probably be of shorter duration, thus causing any impacts to be over a shorter time period.

3.14.3.6 Effects of Alternative B, C, and D

Same as discussed in Section 3.14.3.2, Direct Effects Common to All Alternatives. The only differences anticipated between these three alternatives might be the duration of mining. For example, if multiple seam mining is allowed under Alternative C, the duration of mining would be greater than Alternative B. Similarly, the mining under Alternative D would be greater than Alternative B, but may be less than Alternative C as certain areas are protected from subsidence, thus minimizing the amount of coal mined in certain selected areas.

3.14.4 Other Transportation Options

As discussed in Section 2.7, Transportation Options, scoping commentors requested that options be discussed to two main issues:

- Coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout; and
- The ability of the Union Pacific Railroad to handle increased coal tonnage from the mines in the North Fork Valley.

In response to these issues, the effects of certain options are discussed below.

3.14.4.1 Issuance of Only One Lease

The issuance of only one of the two leases in the North Fork Valley may, or may not, have any effect on total coal production from the North Fork Valley. The mines in the North Fork Valley have all indicated their plans to increase coal production from their existing operations. See *Table 3.14-2, Coal Production From North Fork Valley Coal Mines*. Given other federal and private reserves in the area, issuing only either the Iron Point or the Elk Creek Coal Lease Tract does not guarantee that there would be less coal production, or less highway coal truck or railroad traffic in the region.

3.14.4.2 Production Limits

There were comments received during scoping about the potential of setting production limits on the Iron Point and Elk Creek Coal Lease Tracts. Setting such limits does not guarantee that coal production from the North Fork Valley would be limited. However, setting production limits could greatly impact, and possibly hinder, the economics of mining, particularly the economical production levels required by longwall mining. See *Appendix E, Mining Economics*. In setting production limits on the Iron Point or Elk Creek Coal Lease Tracts, mining companies may choose to look at adjacent private or existing federal reserves for mining operations. In addition, in setting production limits, the federal government may not receive full royalties from coal and may hinder the maximum recovery of the coal resource.

3.14.4.3 Increase Capacity of Highway Coal Trucks

At present, both Bowie and Oxbow are using highway coal trucks with the capacity to haul 28 tons of coal. There has been some discussion about the potential of increasing that capacity to 45-ton highway trucks. Such an increase would require approval of the Colorado Department of Transportation, if such larger capacity trucks are to use State Highway 133.

If possible to increase tonnage from 28 to 45 tons per truck, the ADT for coal haulage would be less. See *Figure 32, Coal Truck Traffic vs Coal Tonnage Shipped*. For example, at a coal production level of 5 million tons per year there would be 978 ADT for 28-ton trucks as compared 608 ADT for 45-ton trucks. This would result in a reduction of 370 ADT, or approximately a 38 percent reduction in coal truck traffic.

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3.14.4.4 New Rail Loadout Adjacent to Bowie No. 2 Mine

One way to eliminate coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout would be the construction of a new rail loadout adjacent to the Bowie No. 2 Mine that would replace the Bowie No. 1 Loadout. This action would reduce coal truck traffic. At a production level of 5 million tons per year using 28-ton trucks 978 ADT would be eliminated. Similarly, at lesser production rates, the ADT for coal truck traffic would be reduced. See *Figure 32, Coal Truck Traffic vs. Coal Tonnage Shipped*.

Elimination of coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout has the potential to decrease highway traffic by approximately 21 to 22 percent at a production rate of 5 million tons per year. However, this increased coal truck traffic (at the 5 million ton per year rate) would not affect the operation and design limits of State Highway 133. Similarly, reduction of traffic would decrease to the potential for less accidents, but to what specific amount is difficult to actually quantify.

Construction of a new railroad loadout at the Bowie No. 2 Mine would not be without its own effects. There would be a financial effect to any company constructing such a facility. See *Appendix E, Mining Economics*. Similarly, there would be disturbances associated with the construction of a new rail loadout facility. An additional 15 to 25 acres of surface would be disturbed for such facilities. Topsoil would be removed prior to construction, and the area would be removed from its current use for agricultural, wildlife, or residential use. With the construction of such a facility, there would be an increased potential for erosion and sedimentation, thus having a potential to impact water quality and fisheries. Such facilities could also have aesthetics and noise impacts.

3.14.4.5 Separate Haul Road

To eliminate coal truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout, it was suggested that a separate, stand-alone haul road be constructed, and off-highway coal trucks be utilized. Similar to the discussion in Section 3.14.4.4, New Railroad Loadout Adjacent to Bowie No. 2 Mine, this option would eliminate highway coal truck transportation on approximately 3 miles of State Highway 133; however, this option is not without impacts of its own.

The construction of a stand-alone haul road for 3 miles would probably disturb 50 to 150 acres, depending on its location and the amount of "cut and fill." Similarly, there would be increased noise and air pollution from coal haulage. There would be the need to acquire the right-of-way and build the road, which could cause increased sedimentation and impacts to wetland/riparian areas. The area in the North Fork of the Gunnison River Valley is constricted, and any construction of a separate stand-alone haul road might require substantial cuts and fills. There would also probably be the need to have an overpass or underpass on State Highway 133 to prevent the large off-highway coal haulers from interfering with normal traffic on State Highway 133.

3.14.4.6 Conveyor

This option would be similar to a separate haul road as discussed in Section 3.14.4.5, Separate Haul Road. Constructing a conveyor from the Bowie No. 2 Mine to the Bowie No. 1 Loadout would have similar constraints, although a conveyor right-of-way would be much narrower than

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a haul road corridor. Construction of a conveyor over a 3 mile distance in this area would probably impact 10 to 20 acres.

3.14.4.7 Capacity of North Fork Branch

With its current configuration, the North Fork Branch of the Union Pacific Railroad can handle up to 20 million tons of coal production per year and six trains per day (round trip) from the North Fork mines (Paul Connor, 1999 personal communication). The North Fork Branch could handle coal tonnage greater than 20 million tons per year, but additional railroad sitings would be needed to allow increased train traffic.

3.14.5 Possible Mitigation and Monitoring

The primary goal of any mitigation program with regard to transportation would be focused on reducing the potential for accidents. In this light, the following suggestions are made:

1. Place increased signage on State Highway 133 between Paonia and the West Elk Mine; this signage would be effective in warning motorists that heavy truck traffic is possible over this stretch of highway.

2. Post reduced speed signs for the stretch of State Highway 133 between the Bowie No. 2 Mine and the Bowie No. 1 Loadout. This would also be effective in lowering noise levels.

3. Improve the ingress and egress areas of the Bowie No. 1 Loadout on to State Highway 133 to provide for better visibility and/or easier merging of coal truck traffic with existing traffic.

4. One way to reduce the potential for accidents at railroad crossings with roads is to eliminate the potential for train-vehicle interaction. The potential of closing certain crossings, specifically in Paonia, would be effective and could be evaluated. The communities could target priorities for highway/railroad crossings. With such priorities, the appropriate officials and groups cold work to obtain federal or state funds to improve the signage or lighting at railroad crossings.

   Certain crossings might be targeted for grade separation, that is the construction of an overpass (or underpass), which would be effective in separating the railroad from the highway. Construction costs could approach $10,000,000 for such an undertaking.

   Another option would be the re-routing of train traffic around populated areas, such as the communities of Paonia, Hotchkiss, and Delta. This would eliminate rail traffic within the towns. Estimated costs for this option could involve $1-5,000,000 per mile of new construction, as well as certain environmental consequences (disturbances to wetlands and/or wildlife habitats, erosion and sedimentation potential, aesthetics, etc.).

5. Although most emergency service providers understand and have considered the need for providing emergency services on each side of the tracks, with increased coal shipments on the railroad, this need should be re-examined. In some cases,

the emergency service providers may need additional emergency equipment and personnel on either side of the tracks, available to respond in an emergency situation.

6. Improved communication capabilities between the Union Pacific Railroad and local emergency service providers would be beneficial. In emergency situations, rapid communication is always essential in minimizing or preventing property damage and fatalities.

7. Awareness can lead to less accidents. Government officials, the Union Pacific Railroad, the mining companies, and concerned citizen groups should continue their efforts to educate employees, the general public, and visitors to the area about highway safety and accident prevention. Increased awareness can be effective and result in lower accident rates.

3.15 SOCIOECONOMICS

Issue: *Address the social and economic impacts on local residents of Delta and Gunnison counties. Areas of concern include: impacts to nearby communities as the result of mine closures or continuation of mining and such impacts on housing, utilities, employment, public services, community services, and present lifestyles; the effect of mine closure on workers and their families; the influx of new workers if production rates increase; and, the effects of temporary and permanent mine shut down.*

3.15.1 Introduction

This section provides an overview of the socioeconomic aspects of the existing conditions of the area, as well as the impacts associated with pending decisions on the proposed coal exploration license and lease applications. The discussion in this section differs from previous sections. The analysis will compare the potential impacts for all alternatives, including the No-Action Alternative, to the existing conditions. It was felt that portrayal of information in this fashion would be more informative to the reader and the decision makers.

For purposes of the socioeconomic assessment, primary, secondary, and tertiary study areas are defined as follows:

- The primary study area is the geographic area that is anticipated to be most directly affected by the potential project. This is defined to include all communities within Delta County.

- The secondary study area is the geographic area expected to be indirectly affected by the potential project. This area covers all of Delta and Gunnison Counties.

- The tertiary study area covers an even larger geographic area that is expected to experience broader cumulative social effects and provide a context for other non-mine related changes occurring in the primary and secondary study areas. For this analysis, the tertiary study area is defined to include the seven-county central western slope area of Delta, Gunnison, Mesa, Montrose, Ouray, Pitkin, and San Miguel.

Additional details regarding the socioeconomics of the area are set forth in Appendix L, Socioeconomic Report.

3.15.2 Existing Conditions

The discussion of existing conditions provides a review of existing conditions in area communities. This baseline assessment is then used to measure potential economic and fiscal impacts associated with each project alternatives.

3.15.2.1 Population

As of 1998, approximately 26,600 residents live in Delta County, the primary study area. Population has increased by 3 percent annually since 1990. This rate of growth is faster than the rate of growth occurring in the broader secondary and tertiary study areas as well as statewide.

The City of Delta is the largest incorporated community in the primary study area with 5,600 residents residing within the city limits; this amounts to 21 percent of all residents living in the primary study area. After Delta, the next largest cities are Orchard City, Cedaredge, Paonia, Hotchkiss and Crawford, respectively. Together, the incorporated communities within the primary study area account for nearly 50 percent of total Delta County population.

The two-county secondary study area has a combined population of 39,075 as of 1998. Secondary study area population has increased at an average rate of 2.8 percent annually since 1990, with the greatest increase occurring between 1993 to1995.

At any given time, an estimated range of 88 to 96 percent of Bowie, Oxbow (Sanborn) and West Elk mine employees live in Delta County. A range of 56 to 67 percent of mine employees typically live in the Paonia/Hotchkiss area.

The Colorado Department of Local Affairs forecasts that Delta County's population can be expected to increase by another 16,000 residents over the next 20+ years. This equates to an average growth rate of 2.2 percent annually, a rate of growth below what has occurred over the last eight years. Population in the secondary study area is forecast to grow at a similar rate annually (2.1 percent).

3.15.2.2 Housing

Current household size in the primary study area is 2.4 persons per household. Household size in the primary study area has been declining, the result of a transition to smaller families.
In 1997, 347 single family homes were sold in Delta County, 176 fewer sales than in 1994. This decline in sales volume corresponds with slowing net in-migration of new residents. Average sales price of a single family home in Delta County varies by community. Highest priced homes can be found in the Cedaredge and Paonia areas. The reported average sales price in the Paonia area has declined from $139,900 in 1995 to $89,800 in 1997.

3.15.2.3 Demographic Characteristics

An estimated 11.7 percent of the residents living in the primary study area represent racial and ethnic minorities, above the proportion in secondary study area (at 9.9 percent), but well below statewide levels (at 21.0 percent). Hispanic residents represent the largest minority/ethnic group, accounting for 10.5 percent of Delta County's population.

Primary study area residents tend to be older than secondary study area residents. Almost 49 percent of primary study area residents are age 45 and older, compared to 41 percent in the secondary study area. The primary study area population also is aging. Over 69 percent of the population growth in the primary study area comes from persons aged 45 and older. Seniors (65+) account for 23 percent of all new residents.

3.15.2.4 Employment and Economic Conditions

Participation in the Delta County labor force is well below labor forces participation rates in the larger secondary study area and statewide. In 1997, only 50 percent of the population age 16 and older in Delta County was employed or actively seeking employment. In the secondary study area, 60 percent of residents age 16 and older were employed or seeking employment. As of April 1999, the unemployment rate in Delta County was 5.9 percent, more than twice the statewide rate of 2.7 percent. Local unemployment consistently runs about 1½ to 2 percentage points above the statewide average.

Delta County population migration appears to closely parallel employment growth. Years of greatest net out-migration coincide with years of significant job losses, illustrating that when Delta County loses jobs, local population growth tends to slow or decline.

In 1996, approximately 11,370 workers were employed in Delta County (including self-employed). Employment has increased by almost 27 percent since 1980. Fastest-growing industries include services (+98 percent), wholesale trade (+78 percent), and construction (+62 percent). The only industries reporting a decrease in employment since 1980 are agriculture and farm (-20 percent), finance, insurance, and real estate (-23 percent), and mining industries (-65 percent).

As of 1996, self-employment is estimated to represent the largest single job sector in Delta County. Over 30 percent of all workers are self-employed (non-farm), a greater proportion than in the secondary study area or statewide. The number of non-farm self-employed workers increased by 21 percent between 1980 and 1996 in Delta County.

Over the last 17 years, the coal mining industry in Delta County, as well as in the secondary study area and statewide, has undergone a period of economic restructuring. In 1981, nine active coal mines produced almost 3.0 million tons of coal in the secondary study area (covering Delta and Gunnison Counties), representing 15 percent of total production statewide.

By 1986, only three active mines remained producing 1.3 million tons of coal, representing only 8 percent of statewide production.

Since 1986, the coal mining industry in the secondary study area has rebounded. However, the primary production of coal has shifted towards Gunnison County. The two county secondary study area is now producing almost 30 percent of the state's coal.

Both Delta and Gunnison counties have experienced substantial employment growth from 1980 to1996. This overall employment growth has occurred even as mining-related employment has declined, leading to a more diverse economy in both the primary and secondary study areas.

While mine employment has declined, mines have restructured to achieve substantially greater productivity in a more competitive domestic and global market.

3.15.2.5 Income

In 1996, personal income per capita in Delta County averaged $16,400 (after adjusting for inflation), 4 percent below the $17,000 per person living in the secondary study area and 36 percent below $25,700 average experienced statewide. Personal income is the amount of income an individual receives annually before taxes. It includes wages, salaries, proprietor's income, other labor income, investment income, and transfer payments. Between 1980 and 1996, personal income per capita in Delta County increased by 19 percent, compared to 24 percent in the secondary study area and 33 percent statewide.

As of 1996, residents in Delta County earn less in wages, salary and proprietor's income than from transfer payments (e.g., retirement, unemployment insurance, government payments) and investment income. Only 32 percent of personal income is from wage and salary sources, down from 36 percent in 1980.

In 1996, average wage per worker in Delta County was $15,700 compared to $17,100 in the entire secondary study area and $28,400 statewide. Highest-paid wages were in the mining sector where the average Delta County worker earned $47,600, more than three times the county wage average for all sectors and $18,400 above the next highest paying sector.

3.15.2.6 Community and Public Services

As part of the EIS process, area community and public service providers were contacted to ascertain information regarding current services provided together with possible public service effects due to prospective changes in mining activities in the Bowie and Somerset areas of Delta and Gunnison counties. This assessment focuses on the primary study area in Delta County, where the majority of mine employees currently reside.

County Governance - The primary study area consists of six incorporated communities, with the rural unincorporated portion of Delta County under the auspices of county government. The Iron Point Exploration License Area, the Iron Point Coal Lease Tract, and a portion of the Elk Creek Coal Lease Tract are situated in unincorporated Delta County. A portion of the Elk Creek Coal Lease Tract extends into unincorporated Gunnison County.

Education - Public education service providers in the primary study area include the Delta County Joint School District, the Gunnison Watershed School District and the Delta-Montrose Area Vocational Technical Center. Most children of current mine employees attend Delta County Joint School District schools. The Delta County Joint School District serves nearly 4,700 households in Delta County and portions of Montrose, Gunnison and Mesa Counties with 14 schools and a vocational technology school.

Enrollment has not increased in the past three years. Overall, the 14 schools in the district are operating at 71 to 73 percent of the indicated 6,400 to 6,500 facility capacity. One school (Garnet Mesa Elementary) is at full capacity and another school (Hotchkiss Middle School) is operating at less than 50 percent of indicated enrollment capacity.

Area schools also provide services of importance to coal mines operating in Delta and Gunnison Counties. The Delta-Montrose Area Vocational Technical Center, 5 miles south of Delta, provides training for mine workers, emergency medical technicians (EMTs), paramedics and OSHA certification.

Ambulance Services - Delta County ambulance service is divided between the North Fork Ambulance Service (serving Paonia, Hotchkiss and Crawford) and the Delta County Ambulance Service (serving Cedaredge, Orchard City and Delta). These ambulance services provide basic life support, emergency care, and transport.

To date, little direct impact to ambulance service reportedly has been experienced due to mine operations and associated unit train traffic. Generally, delays tend to last five to seven minutes; however, not all train crossings are blocked at the same time. Emergency vehicles typically can access unblocked crossings and go around the trains. To help minimize any serious delays due to possible train blockages, communities in the Delta County Ambulance District alternate the side of the rail line on which the ambulance is parked.

The Delta County Ambulance Service has no arrangement with the mines for service. Mines have on-site first aid staff or EMT personnel and ambulances.

Fire Protection - Each Delta County incorporated jurisdiction and of the unincorporated county is part of a fire district. Five fire districts serve the primary study area and the Somerset portion of Gunnison County.

Paonia Fire District 2 (closest to the North Fork mines) provides fire and rescue services to a population of approximately 5,000 in a 30,500-acre (48 square mile) area. Recent voter approval to double the mill levy indicates the community's commitment to and awareness of the services provided.

Law Enforcement - A combination of county sheriff and city police departments provide law enforcement services in the primary and secondary study areas. The police forces of the towns of Paonia, Hotchkiss, Cedaredge and Delta work cooperatively with the Delta County Sheriff's Department, while the communities of Crawford and Orchard City rely completely on the Sheriff's Department because they do not have police departments of their own.

Water Supply, Wastewater Treatment and Solid Waste - Municipal water service is provided for each of the incorporated cities in the primary study area of Delta County. Municipal sewage and wastewater treatment is provided in all of the incorporated communities except Orchard City. In rural areas, with the exception of portions of the Paonia and Cedaredge rural areas, residents rely on private domestic or community water systems.

Delta County has an EPA-approved landfill in the Tongue Creek area, with a transfer station in the North Fork area. Solid waste service is available through private contractors in all communities.

Paonia's public works priority is to build a new sewage treatment plant to come into compliance with EPA regulations. The city is also studying additional water storage capacity.

Approximately 22 households in Somerset are on a sewage system, with the remainder of the community served by septic tanks. This sewage system is near capacity, and many households with septic tanks would like to come on the sewage system.

Crawford's lagoon is at 25 percent of capacity according to EPA standards, and the town is planning more water lines. The town is planning an expansion of the sewer ponds.

Hotchkiss water and sewer systems currently have capacity to serve added growth. With stricter EPA regulations and the anticipated need for more water storage, the town is currently conducting a water study. The study is due to be finished by the end of 1999.

Delta's sewage treatment plant is approximately 15 years old and operates well below available capacity. Delta buys water from the Project 7 water supply in Montrose. Project 7 treatment plant capacity is questionable. The plant was not built to meet new regulations, and Project 7 plans to expand the water treatment plant and to add storage.

In Orchard City, a new building for water filtration is under construction at an estimated cost of more than $750,000.

Cedaredge's updated water treatment plant is one of three national finalists for a national EPA award for Most Improved Small System Wastewater Treatment. The plant is near capacity, so the city is considering further enlargement updating or the construction of a new plant at a different location.

Hospital and Medical Services - Delta Hospital, in Delta, operates as a full-service, general acute care hospital with 49 beds, home health care, a staff of 28 doctors, and 198 full-time and 89 part-time employees. The hospital's primary service area comprises Delta County together with the communities of Olathe in Montrose County and Somerset in Gunnison County.

Electrical Utilities - Tri-State Power generates and sells power to 32 member stations throughout Colorado. These include Delta Montrose Electric Association and Gunnison Electric within the primary and secondary study areas. Delta Montrose Electric's service area includes East Montrose County, western Gunnison County, and all of Delta County. North Fork area mines are paying members of the Delta-Montrose Electric Association.

To accommodate operating mines, the co-op has made several changes over the years, such as upgrading Waunita, the sub-station located near Bowie that serves the North Fork mines. Delivery points and land taps were added.

Social Services - Delta County Social Services provides public assistance to low-income families and the elderly. Overall, case loads are decreasing except for assistance to the elderly which has been increasing.

Roads - In the Paonia-Hotchkiss-Crawford area, most of the truck traffic is not mine-related. Coal is primarily moved by train. The exception is truck traffic from the Bowie No. 2 Mine to the Bowie No. 1 Loadout. Highway 133 is considered a scenic route and is traveled by tourists.

According to a variety of local community and public service providers contacted for this socioeconomic assessment, train blockage represents an issue of concern related to current and prospective mine operations. For example, EMT service can be delayed five to seven minutes when crossings are blocked.

3.15.2.7 Fiscal Conditions

The federal government receives revenue from land and mineral rights leases, as well as royalties. The State of Colorado receives tax revenues primarily from federal royalties, sales, severance, and income taxes. Local governmental entities receive property, sales, and severance taxes, as well as a share of the federal royalties.

State of Colorado Revenues - Net state and local revenue collections in Colorado totaled $6.3 billion in 1998. Severance tax, which gets redistributed back to local jurisdictions, accounts for only 1 percent of all Colorado tax collections statewide.

County Revenues and Expenses - Taxes represent 69 percent of total county revenues in Delta County and 64 percent of revenues in Gunnison County. Tax revenues also are increasing more rapidly than all revenues combined.

On the expenditure side, general governmental expenditures account for 55 percent of county expenditures in Delta County and 59 percent in Gunnison County. Growth of general governmental expenditure also is outpacing total expenditures in both counties. Education is the top expenditure in both Delta and Gunnison Counties Public safety represents the number two expenditure item in both counties.

Retail Sales Tax - While Gunnison County has fewer permanent year-round residents than Delta County, the level of retail sales is higher in Gunnison County than Delta County, at $358.8 million versus $289.2 million respectively. Higher retail sales levels in Gunnison County are primarily due to a substantially larger tourism industry than Delta County.

Businesses within the City of Delta captured over $161 million worth of retail sales in 1998, representing 56 percent of all retail sales in Delta County.

Property Tax - In 1998, over $8.6 million in property taxes were collected in Delta County. Almost 48 percent came from residential properties, the largest source of property tax revenues. Total tax assessed valuation for Delta County (as of 1998) was $167.1 million.

In 1998, coal mines represented $5.7 million of Delta County assessed valuation and $31.5 million in Gunnison County for a combined valuation of $37.2 million. Railroads serving the coal mines within the secondary study area also constitute a major property tax revenue source. In 1998, their assessed Delta County value totaled $4.1 million.

Severance Tax - In 1998, Colorado coal mines generated over $9.3 million in severance tax revenues. Since 1989, the long term trend in severance taxes paid in Colorado generally was up, but with significant year-to-year variations.

Because much of the mine activity is located outside the communities where mine employees live, Colorado has implemented a severance tax to help communities pay for services provided to mine employees. Based on state severance tax records, 278 mine employees live in Delta County. State severance tax records also showed that nearly 47 percent of these employees live in Paonia, which received almost $51,800 in severance taxes in 1998.

Federal Royalties - In 1998, coal mines in Delta County generated $742,400 in federal royalties. One-half of this amount was returned to Delta County. The mines in Gunnison County generated over $6.6 million in royalties; Gunnison County received one-half or $3.3 million.

Energy Impact Grant Program - An energy impact grant program is available to Colorado communities to fund projects ranging from bridges to recreation. Funds for this program come from a variety of sources. Available funds statewide totaled $12 million in 1998.

3.15.2.8 Recreation

Tourism plays a larger role in the Gunnison County economy than in Delta County because of mountain-oriented resort activity. Gunnison County has several resort communities, Crested Butte being one of them.

In 1997, tourists spent nearly $21.4 million in Delta County. Over $130 million was spent by tourists in the entire secondary study area, 84 percent captured by Gunnison County.

Travel spending in Delta County generates about 380 jobs, half of which occurs with dining establishments. Average wage in the tourism sector is $10,200 per year, $5,500 less than the average wage for all Delta County workers. Approximately 1,920 jobs are supported by travel spending in the two-county secondary study area.

3.15.2.9 Social Values

By combining community and public service information with psycographic data, it is possible to arrive at several overall observations regarding social values of the Delta County rural communities most directly connected to current and potential future mining activities:

- Communities along the North Fork of the Gunnison River have a long history with coal mining extending back to the late 1800s; however, like much of the American West, the primary study area of Delta County is in transition both economically and culturally. Local communities are becoming more diversified with less dependence on coal mining as a source of income but with continued economic benefits from the relatively high-wage jobs associated with mining.

- The primary study area has not yet experienced the rapid in-migration occurring elsewhere in counties of Colorado's central western slope region; however, there is evidence of growing difference in social values of newcomers versus long-time residents. It is generally believed that newer residents are less supportive of traditional rural area natural resource activities, includes ranching, farming, logging and mining.

- In Delta County, over 60 percent of households are identified with demographic and lifestyle characteristics of "rustic living." These households tend to come from a tradition and/or remain actively involved in making a living from the land, including agriculture, logging mining and construction. Households who fit in this "rustic living" category comprise only 17 percent of the central western slope and 5 percent of all Colorado households, and are therefore less likely to represent in-migrants to Delta County.

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- A number of primary study area residents tend to value the economic opportunity represented by North Fork mining activity. However, expanded coal mining also raises concerns of potential negative lifestyle effects. These concerns include issues such as train noise/crossing blockage, and effects of future temporary or future closures on mine workers, their families and affected communities.

- Whether or not coal mining is viewed as having a positive or negative effect on quality of life depends on the values that receive greatest emphasis from different residents of the North Fork region. Those who place greater emphasis on the economic stimulus and continued job opportunity presented by ongoing coal operations tend to be supportive of continued or expanded coal operations. Conversely, those who chose to reside in the area and to leave behind the hustle, bustle, noise and pollution of urban living and modern industrial society, raise questions or are less favorable to ongoing or expanded North Fork coal mine operations.

3.15.2.10 Land Ownership and Values

An estimated 56 percent of Delta County land is in public ownership with another 37 percent in agricultural use. Only 7 percent of all land is in non-agricultural private ownership. As of 1998, total assessed value in Delta County was $167.1 million.

Only 4 percent of Delta County's tax assessed valuation consists of natural resource related properties. These include mine properties.

3.15.3 Environmental Consequences

The socioeconomic effects discussed in this section consider information presented in Section 3.15.2, Existing Conditions. In addition, projections regarding mine production and operations were used for the impact analysis. Economic multipliers specific to the study area were derived from the IMPLAN economic model.

IMPLAN is an economic model providing information that identifies the relationships between multiple economic sectors at the county level. The model was developed for the Forest Service and draws on a national database from the U.S. Bureau of Economic Analysis and provides data for 528 economic sectors. The state of Colorado also has an economic impact model. This model only provides information for 38 aggregated industries by region. This Colorado model places Delta County in one region and Gunnison in the other region. This division and the greater level of economic sector detail are reasons that the IMPLAN model was used for assessing economic impacts in this EIS; however, data from the Colorado State Department of Local Affairs were incorporated into the analysis.

Direct and indirect socioeconomic impacts are evaluated for the two-county secondary study area. Fiscal effects are evaluated primarily in terms of direct consequences, as indirect effects are less readily quantified. Cumulative impacts are discussed primarily in the context of the larger seven-county tertiary study area.

3.15.3.1 Mine Development Assumptions

The principle difference between alternatives relates to the amount of coal reserves associated with each alternative. This affects the anticipated life of the existing mines. *Table 3.15-1, Total Projected Mine Life*, illustrates the estimated mine life for the alternatives.

Table 3.15.1
Total Projected Mine Life

Alternatives	**Mine Life (years)**	
	Bowie No. 2[1,2]	**Oxbow[1]**
A[3]	1.5	5
B[4]	6.5	10
C[5]	9.5	11
D[6]	9	11

Notes:

1. For purposes of this table, it is assumed that coal reserves in the Iron Point Coal Lease Tract would be mined using the Bowie No. 2 Facility, and coal reserves in the Elk Creek Coal Lease Tract would be mined using the Oxbow facilities.
2. The estimates for the Bowie No. 2 column do not reflect the mine life for B seam reserves beneath the present Bowie No. 2 D seam mining or for the Bowie No. 1 "pod" of coal reserves, located to the west of Terror creek. Under Alternatives B, C, and D, it is assumed that the Bowie no. 1 "pod" reserves could be accessed through entries in the Iron Point Coal Lease Tract. Mining the Bowie No. 1 "pod" could add approximately 2 years to the life of the Bowie No. 2 operation.
3. Leases would not be issued for the Iron Point and Elk Creek Coal Lease Tracts. Mine life illustrates remaining Bowie No. 2 and Oxbow reserves.
4. Assumes approximately 5 years of mine life for each lease tract, added to the projected mine lives of Alternative A.
5. Assumes multi-seam mining and expanded lease tracts. Estimated 8 years from Iron Point Coal Lease Tract and 6 years from Elk Creek Coal Lease Tract, both added to projected mine lives of Alternative A.
6. Similar to Alternative C, except with subsidence restrictions. Assumes loss of about 0.5 year of mining from Iron Point Coal Lease Tract due to subsidence restrictions. Coal reserves in the Elk Creek Coal Lease Tract could be somewhat less under Alternative D as compared to Alternative C, but not enough to affect projected mine life.

Under Alternative A (No-Action Alternative), leases would not be issued for the Iron Point and Elk Creek Coal Lease Tracts. Under this scenario, the Bowie No. 2 Mine has approximately 1.5 years of reserves, and the Oxbow operation has approximately 5 years of reserves.

Under Alternative B, an additional 5 years of reserves would be available for both the Iron Point and Elk Creek Coal Lease Tracts at production rates discussed in Chapter 2, Alternatives Including the Proposed Action. With Alternatives C and D, approximately 8 years of additional reserves would be available for the Iron Point Coal Lease Tract and approximately 6 years for the Elk Creek Coal Lease Tract. Coal reserves available in Alternative D would be somewhat less than Alternative C because of the subsidence restrictions. However, this would not materially affect the projected mine life. For all of the action alternatives, access could be provided under Terror Creek to the reserves in the Bowie No. 1 pod. It is estimated that there are 2 years of reserves in the Bowie No. 1 pod.

Each mine anticipates additional capital expenditures for coal extraction with any of the Action Alternatives B, C, and D. The identified capital expenditures for both mines total an estimated $31 million.

For the Elk Creek Coal Lease Tract, it is anticipated that 30 to 40 construction workers would be needed to develop the Elk Creek portal and related facilities on Oxbow private surface. Construction should be completed in less than a year; therefore, any socioeconomic effects would be short–lived. For this construction work, there should be no need to attract new workers into the two-county study area.

Combined annual purchases for both mines are estimated at $49 million. It is anticipated that 20 percent of operating purchases annually would be made within the local study area.

With Alternatives B, C, and D, operations employment at each mine is not anticipated to increase significantly above current conditions. This means the 168 mine workers at Bowie No 2 (up from 157 people for room and pillar mining) and the 215 mine workers (mine workers and contract operators) at the Oxbow operations. These work forces would be assigned to the Iron Point and Elk Creek Coal Lease Tracts respectively. With no anticipation of significant additional mine workers for these new lease tracts, population, housing and school enrollments should be unaffected compared to existing conditions.

Data from the IMPLAN model was used which identified an average annual wage for mineral extraction construction workers at $24,600. Estimated average annual wage during the period of mine operations is $59,500 per employee.

3.15.3.2 Socioeconomic Effects of Alternative A (No-Action)

Socioeconomic effects of the No-Action Alternative (Alternative A) would occur due to a reduction in coal mine activities within the local study area. Under a No-Action Alternative, mining of reserves at existing mines would continue at current extraction rates until reserves are depleted.

To be conservative, impacts associated with a No-Action alternative are expressed as maximum potential effects on an annual basis after cessation of existing operations at the Bowie and Oxbow sites.

Employment and Income - Combined effects of discontinuing operations at the existing Bowie No. 2 and Oxbow Mines would represent loss of 383 jobs. Averaging $59,500 in annual salary, total lost payroll would approximate $22.8 million annually.

For every mine worker in the local study area, an estimated 1.7 workers are supported by mining operations and mine worker household purchases. If both mines were to close, then an estimated 650 locally supported non–mine jobs in Delta and Gunnison Counties could potentially be negatively affected due to the drop in mining activity.

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For every $1.00 earned by mine workers, another $0.52 in income is supported in the local study area. Closure of both mines could lead to a reduction of $11.9 million in non-mine related income throughout the affected study area.

Total direct and indirect mine closure effects could represent a loss of up to 1,033 jobs and over $34.6 million in annual payroll.

On a cumulative basis, if affected workers left the two-county study area, a substantial number likely would choose to remain within the broader seven-county central western slope area, as considerable inter-county migration occurs within the broader study area. According to IRS migration data for 1996–1997, almost 30 percent of residents leaving Delta County moved to other central western slope counties. Approximately 80 percent moved to neighboring Mesa and Montrose Counties.

Housing, Population and School Enrollment - If both mines ceased operations, more than 800 residents (145 of school age) would be directly affected. Whether these children would remain enrolled in local schools would depend on whether parents choose to relocate elsewhere to find employment or remain in the local study area.

Combined, these two mine closures could affect nearly 2,380 residents living in the local study area, over 410 of them school–aged children.

If a significant portion of residents choose to migrate outside the area, the local housing market could experience at least a temporary downturn (e.g. decline in property values) because a large number of homes might come onto the market simultaneously, potentially driving down prices. Local schools also would be affected, as a substantial portion of students could eventually relocate outside of the district.

On a cumulative basis, with the No-Action Alternative, a significant portion of residents could be expected to relocate to other communities within the central western slope region. The number of low-income families living in the greater central western slope area could also increase.

Other Community and Public Services - Over a short-term period of job loss (with mine cessation), needs for some community and public services can be expected to increase. Examples are law enforcement and social services.

The economic multiplier relationship of direct to indirect employment could create further service demands from dislocation of workers currently supported by mining activity. A second type of indirect effect would result from reduced local tax revenues as local incomes declined and/or property values decline, whether temporarily or longer term.

Community and public service providers would be affected by this combination of direct and indirect effects. If not offset by alternative sources of revenue, the level of service available from existing providers would decline.

On a cumulative basis, if alternative employment were not available to displaced mine workers, some households could be expected to relocate to other communities in the central western slope area. This could increase demands for community and public service providers in the communities affected.

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Recreation, Social Values, Land Ownership and Values - Differing effects may be experienced, based on such factors as the perspective of a particular individual or social group, geographic area considered, and time elapsed from implementation of a No-Action Alternative.

Effects that might be expected are varied, potentially including:

- Reduced recreation from those displaced directly or indirectly by mining cessation, perhaps offset in part by those using recreation lands for hunting or fishing activity.
- Diminution in income levels and quality of life for those displaced directly or indirectly from mine closure.
- Potential enhancements in quality of life for some residents whose economic livelihood is not related in any substantial way to mining activity; a specific example would be reduced train activity and associated noise and crossing blockages.
- For at least the short-term, property values might decline if a substantial proportion of displaced workers decided to place their homes on the market and relocate from the area.

Over time, on a cumulative basis, cessation of mining would continue the trend toward in-migration of persons less dependent on traditional natural resource activities throughout Colorado's central western slope region.

Fiscal Effects - The state of Colorado and local jurisdictions in Delta and Gunnison counties currently receive an estimated $11.4 million in combined annual tax revenue related to operations of the Bowie No. 2 and Oxbow mines and mine-related employees. Of this amount, 52 percent accrues to state government and 48 percent to local governments in the secondary study area.

With cessation of mine operations, payment of tax revenues attributable directly to mine operations ($9.7 million annually) would cease. A portion of the remaining $1.7 million in taxes attributable to mine workers might continue to be received, depending on factors such as ongoing employment for reclamation, unemployment payments while workers are displaced, eventual ability to obtain re-employment, and need for relocation.

As stated in Section 3.15.2.7, Fiscal Conditions, local governments receive a share of the above revenues. Reduction in these revenues would place a burden on local government to provide services at levels that presently exist. With a decrease in revenues, these agencies may need to eliminate services, lower their level of service, or find alternate funding sources. In addition, local government would lose a portion of the following estimated annual revenues: $5.7 million in federal royalties, $2.1 million in state severance tax, and $1.8 million in state sales tax.

3.15.3.3 Socioeconomic Effects Common to All Action Alternatives

Because no significant changes in mine employment are anticipated, socioeconomic effects are discussed in terms of continuing operations at the Iron Point and Elk Creek Coal Lease Tracts. This means the socioeconomic effects discussed in this section should be viewed as a continuation of existing effects and not as new impacts to the local study area.

Employment and Income - The Elk Creek Coal Lease Tract anticipates the need for 35 construction workers for approximately a year of development of the Elk Creek portal and related facilities on Oxbow private surface. These workers are anticipated to earn $24,600, producing $861,000 in estimated payroll annually.

Total operations employment associated with the Iron Point and Elk Creek Coal Lease Tracts combined would be estimated at 383 jobs with ongoing payroll of $22.8 million annually while both tracts are operational.

During periods when both mines are operating at the same time, these facilities are estimated to support over 1,000 direct and indirect jobs in the local economy and over $34.6 million in annual local income.

Combined, these facilities would support over 210 workers and income of nearly $7.1 million annually during reclamation. After reclamation has been completed, ongoing monitoring would occur at both of these facilities.

Housing, Population and School Enrollment - As with the employment and income effects, the housing, population, and school enrollment effects are presented as a continuation of existing effects and not as new impacts to the local study area.

Taken together, mining activities from the Iron Point and Elk Creek Coal Lease Tracts would represent an estimated 350 households with 833 residents and 145 school age children during mine operations. This would decrease to 78 households with 185 residents (32 school age children) during the subsequent period of site reclamation.

During peak operations, the Iron Point and Elk Creek Coal lease Tracts would support an estimated 1,000 households translating into 2,380 residents with over 410 school age children. With reclamation, the number of households supported directly and indirectly by these mines would drop to just over 210 and 500+ residents with less than 90 school age children.

Other Community and Public Services - At maximum operations, annually recurring effects are expected to be similar for each of Action Alternatives B, C, and D. The primary difference is associated with anticipated duration of mine operations, with Alternatives C and D occurring over a longer time period than Alternative B.

During the period of mine operations, effects on community and public service providers generally could be expected to involve little to no change from current conditions. This is because mine operation employment associated with mining from the Iron Point and Elk Creek Coal Lease Tracts would essentially be the same as at the existing Bowie and Oxbow operations. Upon eventual cessation of mine operations, effects would be comparable to those identified with Alternative A.

On a cumulative basis, little or no change from current conditions would be attributed to lengthened duration of operations with Action Alternatives B, C, and D

Recreation, Social Values, Land Ownership and Values - With Alternatives B, C, and D, effects would include:

- Continued recreation opportunity for existing residents and visitors, but with some potential reduced opportunity for recreation on federal lands in the vicinity of the Iron Point and Elk Creek Coal Lease Tracts.

- Maintenance of incomes, quality of life and social values of existing mine workers and other workers or businesses that benefit indirectly from mine-related activity.

- Potential diminution of quality of life and social values for some residents whose economic livelihood is not related in any substantial way to mining activity; a commonly cited example is increase train activity and associated noise and crossing blockage.
- No change in property values or ownerships is expected due to mine operations over the period of their continuation.

On a cumulative basis, Alternatives B, C, and D would allow continued mining for a period of approximately 5-8 years beyond what is expected with Alternative A. It is conceivable that the life of affected North Fork mines could be extended further if operators successfully secure previously unmined seams on private lands or added federal leases.

Continued mining would offer the opportunity to maintain the social values of primary and secondary study area households that depend on or relate to natural resource-related industries.

Fiscal Conditions- During production from the Iron Point and Elk Creek Coal Lease Tracts, state of Colorado and local jurisdictions in Delta and Gunnison Counties would receive approximately $13.5 million annually in tax revenue. Of this amount, 52 percent accrues to state government and 48 percent accrues to local government in the secondary study area. In addition, mining on the two lease tracts would generate an estimated annual income of $5.7 million in federal royalties, $2.4 million in state severance tax, and $1.8 million in state sales tax. Taxes could fluctuate year-to-year as the mines acquire new equipment, make capital improvements, and as the values of such equipment and improvements depreciate. Taxes and royalties would also be influenced by factors such as the price of coal, coal markets, and mine employment.

Tax revenues and royalties would continue for the life of the mining. Upon project closure and reclamation, tax and royalty revenues would cease. Impacts would be similar to those described for Alternative A at that time.

3.15.3.4 Differences Amongst Action Alternatives

Total multi-year revenues to state and local governments are estimated at close to $70 million with Alternative B and $94 million with Alternatives C, and D. Multi-year revenues are 35 percent greater with Alternatives C and D than with Alternative B due to the longer duration of mining activity. The local government share of total revenues received is estimated at 51 percent with Alternative B and 53 percent with Alternatives C and D.

3.15.4 Possible Mitigation and Management

Coal mining operators would, to the extent practicable, employ local contractors and workers, use the local job service centers, and only go outside the local area to hire if an adequate pool of qualified candidates can not be generated from the local area. Coal mining operators also implement a variety of miner safety and educational training. These actions can be quite effective in promoting local employment and worker safety.

Government officials, the mining companies, concerned citizens, and interested organizations should continue their efforts to work together for the benefit of the local community as a whole.

3.16 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible resource commitments are those that can not be reversed (loss of future options), except perhaps in the extreme long-term. It relates primarily to non-renewable resources, such as coal or cultural resources, or those resources that are renewable only over long periods of time, such as mature vegetation or forests. The mining operation removes coal from the ground; this action results in an irreversible loss of the mineral resource.

Irretrievable resource commitments are those that are lost for a period of time. Examples are: the loss of production, harvest, or use of natural resources such as wildlife habitat or grazing use, until disturbed sites are reclaimed and revegetation success is achieved. For example: if a grazing allotment is in poor condition and is likely to remain so, the time gap between its current condition and its ideal (potential) productivity is an ongoing irretrievable loss. Because of the planned underground mining for the two coal lease tracts, disturbance would be a minimal; less than 1 percent of the lease areas would be affected by drill hole pads, borehole locations and ventilation shafts. During these uses, some existing grazing and wildlife habitat might be disrupted during the estimated life of the mine and for a period thereafter. With reclamation of these disturbed sites, land uses would essentially return to current uses and levels of use or even be enhanced, but this could take a period of time for some resources such as mature aspen stands.

3.16.1 Irreversible Resource Commitment

The irreversible commitment of resources would include the consumption of non-renewable energy or materials, such as diesel fuel and gasoline, effects to topography, coal resources, and cultural resources.

The topography above the underground mining would be permanently altered by subsidence. The topographic changes created by subsidence would be mostly unnoticeable to the naked eye, as longwall subsidence tends to be uniform in nature (see Appendix K, Subsidence Evaluation). The result of subsidence is that the post-mining topography would be slightly lower than the original topography.

Fossil fuels used during the operation and transportation aspects of the coal mining on the two coal lease tracts would result in irreversible commitments.

The mining of the coal from the two lease tracts would be an irreversible use of the coal resource. On the other hand, however, the extraction and use of the coal would make this resource available for society.

Any soil or subsoil material not salvaged prior to disturbance could result in an irreversible commitment.

Any disturbance of cultural sites could result in an irreversible commitment. However, research values could be recovered prior to any physical loss.

3.16.2 Irretrievable Resource Commitment

Any vegetation removed in the areas of the proposed facilities would result in an irretrievable resource commitment. Similarly, such activity could displace wildlife within the direct area of disturbance (e.g., loss of habitat) and some wildlife within a larger area. Reclamation plans and mitigation measures would eventually return vegetation and restore wildlife habitat.

There would be a consumption of water resources during the duration of mining and changes caused by mining. Eventually the hydrology of the area would return to the similar condition that existed prior to mining.

Care in underground mine planning should be taken in order to avoid an irretrievable loss of possible future coal resources located adjacent to the proposed coal leases.

3.16.3 Unavoidable Adverse Effects

There are unavoidable impacts which could occur as a result of mining the coal on the two coal lease tracts. Some of these effects would be short-term, while others could be long-term.

These unavoidable effects could include:

- The generation of fugitive dust (short-term);
- The loss of vegetation and wildlife habitat (short and long-term);
- The consumption of water resources (short-term);
- The permanent alteration of topography by subsidence (long-term);
- The increased demand on public services and utilities (short-term);
- Loss of wetlands, springs and seeps, and changed functions and values of wetlands (short and long-term);
- Increases in noise levels which could affect human aesthetics (short-term); and
- Increased railroad and road traffic (short-term).

3.16.4 Short-Term Use Versus Long-Term Productivity

Short-term uses are those that generally occur on a year-to-year basis. Examples are wildlife and livestock use of forage, recreation, and use of the water resource. Long-term productivity is the capability of the land to provide resources, both market and non-market, for future generations.

Relationships between short-term uses of the environment and long-term productivity occur in all alternatives. Short-term uses such as mining may be said to represent irretrievable commitments of resources. As an example, the removal of vegetation from facility sites certainly prevents the vegetation from serving as forage for wildlife and livestock for a certain period of time. However, after a period of time, which would be based on the reclamation plan, vegetation would again re-establish and serve the desired purpose. This would occur because the basic long-term vegetative productivity would not be destroyed by the short-term use of mining; therefore, no irreversible damage would occur.

Coal mining operations on the two lease tracts would be short-term with mining and reclamation expected to last from a few years up to 10 years. The short-term use of the two federal coal lease tracts would be to recover as much coal as is economically feasible.

Long-term productivity refers to the basic capability of the land to produce according to desired future levels (e.g., vegetation, wildlife habitat, water quality, etc.). Long-term productivity would depend on the reclamation measures applied, the ability to retain soil productivity, and the desired long-term management objectives.

All of the alternatives discussed in this EIS result in short-term uses which irretrievably commit certain resources. Proper reclamation and environmental mitigation should restore any disturbed sites to long-term productivity.

Chapter 4

Consultation and Coordination

4.0 CONSULTATION AND COORDINATION

Throughout the Environmental Impact Statement (EIS) scoping process, the BLM and the Forest Service contacted various federal, state, and local agencies for comments and concerns. These agencies include the following:

- U.S. Army Corps of Engineers;
- Environmental Protection Agency;
- U.S. Fish and Wildlife Service;
- Western Area Power Administration;
- Colorado Division of Minerals and Geology;
- Colorado Department of Wildlife;
- Colorado Division of Air Pollution Control;
- Colorado Water Quality Control Division;
- Colorado Division of Wildlife;
- Delta County; and,
- Gunnison County.

All of these agencies were invited to attend the public scoping meeting held in Hotchkiss, Colorado on April 21, 1999. Representatives of the Colorado Division of Minerals and Geology (DMG), Delta County, and Gunnison County were in attendance at this April 21, 1999 public scoping meeting.

A special meeting was held for those agencies interested in the North Fork Coal EIS on Thursday, April, 22, 1999. Representatives of the Colorado DMG, Colorado Division of Wildlife, Delta County, and Gunnison County attended this "interested agency" meeting. A tour of both the Bowie and Oxbow facilities was conducted on this same day for interested agency personnel.

On Wednesday, April 28, 1999, BLM met with representatives of the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service in Grand Junction, Colorado, to discuss the North Fork Coal EIS.

The BLM also met with representatives of the Environmental Protection Agency in Denver, Colorado on Tuesday, May 18, 1999.

The Draft and Final EIS will be distributed to a number of government agencies. The tentative list of agencies to receive the Draft and Final EIS are listed below. The number of copies needed is also listed.

Copies of EIS

ADVISORY COUNCIL ON HISTORIC PRESERVATION
Office of Architectural and Environmental Preservation
Advisory Council on Historic Preservation
1100 Pennsylvania Avenue, NW, Room 809
Washington, DC 20004 202-786-0505 1(final)

AGRICULTURE, U.S. DEPARTMENT OF

Office of Equal Opportunity
U.S. Department of Agriculture, Room 1345
Washington, DC 20250 202-447-5681 1(final)

Animal & Plant Health Inspection Service
PPQ (APHIS)
Program Planning Staff
U.S. Department of Agriculture
Federal Building, Room 643
Hyattsville, MD 20782 301-436-8247 1

Rural Electrification Administration
Assistant Administrator for Management
U.S. Department of Agriculture, Room 4063
Washington, DC 20250 202-382-9552 1

Soil Conservation Service
Environmental Coordinator of Ecological Sciences Division
U.S. Department of Agriculture, Room 6155
P.O. Box 2890
Washington, DC 20013 202-447-4912 1

USDA Coordinator
National Agricultural Library, USDA
10301 Baltimore Boulevard
USA Publications, Room 002 3(draft)
Beltsville, MD 20705 301-344-3755 2(final)

U.S. Department of Agriculture
Room 102-W
Washington, DC 20250 202-447-5681 5

USDA OPA Publications Stockroom
Room A-325 (Attic)
South Building
Washington, DC 20250 1(final)

Forest Supervisor
Grand Mesa, Uncompahgre and Gunnison National Forests
2250 Highway 50
Delta, CO 81416 970-874-6649 5

Paonia Ranger District
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Paonia, CO 81428 970-527-4131 5

USDA Forest Service
Attention: Environmental Coordination
Rocky Mountain Region
740 Simms
P.O. Box 25127
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COMMERCE, U.S. DEPARTMENT OF

National Oceanic and Atmospheric Association
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DEFENSE, U.S. DEPARTMENT OF

Chairman, Department of Defense
Explosive Safety Board
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Alexandria, VA 22331 703-352-0969/703-352-0891 1

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Deputy Assistant Secretary of the Air Force
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U.S. Army Corps of Engineers
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South Pacific Division
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Washington, DC 20314-1000 202-272-0591 2

ENVIRONMENTAL PROTECTION AGENCY

Environmental Protection Agency
EIS Review Coordinator
Region VIII
999 18th Street, Suite 500
Denver, CO 80202-2466 303-312-6002 5

EPA - Office of Federal Activities
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Washington, DC 20460 202-260-5076 5

ENERGY, U.S. DEPARTMENT OF
Office of NEPA Project Assistance
EH-25/MSGB096A
U.S. Department of Energy
Washington, DC 20585 202-586-4600 3

FEDERAL HIGHWAY ADMINISTRATION
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Federal Highway Administration
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Library of Congress
Madison Building
Exchange of Gifts Division
Federal Documents Section
"C" Street, Between 1st and 2nd, SE
Washington, DC 20540 15

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U.S. Government Printing Office
Jackson Alley, Room A-150
Washington, DC 20401 202-512-0000 1

HEALTH AND HUMAN SERVICES, U.S. DEPARTMENT OF
Office of Special Programs Coordination
U.S. Department of Health and Human Services
Office of the Secretary
303 Independence Avenue, SW, Room 4700
Washington, DC 20201 202-245-7426 1

INTERIOR, U.S. DEPARTMENT OF THE
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Lakewood, CO 80215 5

Bureau of Land Management
Uncompahgre Field Office
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Montrose, CO 81401 5

Bureau of Land Management
NARSC-Library
P.O. Box 20457
Building 50, Denver Federal Center
Denver, CO 80225 1

Bureau of Land Management
1849 C Street NW
Washington, DC 20240 1

Director, Office of Environmental Project Compliance
U.S. Department of the Interior
Main Interior Building
MS 2340
1849 C Street, NW 5
Washington, DC 20240 202-343-2116

Natural Resource Library
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Washington, DC 20240 3

U.S. Fish and Wildlife Service
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5.0 LIST OF PREPARERS

5.1 INTRODUCTION

The Bureau of Land Management (BLM) and the U.S. Forest Service (Forest Service) are the joint lead agencies for the North Fork Coal Environmental Impact Statement (EIS) and are responsible for the contents of this EIS document. The Office of Surface Mining (OSM) is a cooperating agency on this EIS project. S. Edwards Inc. served as the third-party EIS contractor under the direction of the lead agencies and utilized numerous subcontractors in the assemblage of the EIS. A number of individuals have contributed to this document. The academic background and experience of these individuals are presented in this chapter.

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Larry Kline - Federal Lands State Coordinator:

5.5 S. EDWARDS INC.

Sally Edwards - Principal In Charge: MS in Resource Management, 1991, Colorado State University, and BS in Forestry 1976, Colorado State University. Experience in project management of environmental analyses. Experience in forestry in western and southern United States. 13 years with Forest Service, five of which served as District Ranger. President of S. Edwards Inc.

Alan Czarnowsky - Project Manager: BS in Mining Engineering, 1974, Colorado School of Mines. Experience in mining operations and environmental aspects of mining activities in western North America.

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7.0 GLOSSARY

A

AAQS: Ambient Air Quality Standards (set by EPA based on Federal Clean Air Act).

Acre-foot: The amount of water or sediment volume which covers an acre of land to a depth of one foot; an acre-foot is equal to 325,851 gallons or 43,560 cubic feet.

ADT: Average daily traffic - A measure of traffic over a 24-hour period. Determined by counting the number of vehicles (from both directions) passing a specific point on a given road.

Aerial: Consisting of, moving through, found, or suspended in the air.

Affect: To conduct an activity which will impact land, air, or water resources so as to disturb the natural land surface.

Affected environment: A physical, biological, social, and economic environment within which human activity is proposed.

Alluvium: Unconsolidated sedimentary material (including clay, silt, sand, gravel, and mud) deposited by flowing water.

Alternatives: The different means by which objectives or goals can be attained. One of several policies, plans, or projects proposed for decision-making.

Ambient: The environment as it exists at the point of measurement and against which changes (impacts) are measured.

Ambient air quality standard: Air pollutant concentrations of the surrounding outside environment which cannot legally be exceeded during fixed time intervals within specific geographic areas.

Ambient noise level: The composite of noise from all sources near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.

Angle of Draw: The angle that defines the limit of surface subsidence. It is measured as the angle from a vertical projection from the edge of underground coal extraction limit.

ANC: Acid neutralization capacity.

APCD: Air Pollution Control Division of the Colorado Department of Public Health and Environment.

APEN: Air Pollution Emission Notice.

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Aquatic: Growing, living in, frequenting, or taking place in water; in this Environmental Impact Statement, used to indicate habitat, vegetation, and wildlife in freshwater.

Aquifer: A zone, stratum, or group of strata acting as a hydraulic unit that stores or transmits water in sufficient quantities for beneficial use.

Aquitard: A confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer; a leaky confining bed. It does not readily yield water to wells or springs, but may serve as a storage unit for groundwater.

Areal: The spatial extent or location.

Artifact: An object made or modified by humans.

Aspect: The direction toward which a slope faces.

Attachment area: A geographic region with which National Ambient Air Quality Standards (NAAQS) are met; three categories of attainment are defined as Class I, Class II, and Class III on the basis of the level of degradation of air quality which may be permitted.

Audible: Capable of being heard.

B

BA: Biological Assessment - Refers to the information prepared by or under the direction of the federal agency concerning listed and proposed species and designated and proposed critical habitat that may be present in the action area and the evaluation of potential effects of the action on such species and habitat.

Base flow: A sustained or fair-weather flow of a stream.

Baseline data: Data gathered prior to the proposed action to characterize pre-development site conditions.

BE: Biological Evaluation - Refers to the information prepared by or under the direction of the Forest Service concerning listed and Regional Forester Sensitive Species that may be present in the action area and the evaluation of potential affects of the alternatives on such species and habitat.

Best Management Practices: Management actions that are designed to maintain water quality by preventative rather than corrective means.

Big game: Large animals hunted, or potentially hunted. for sport. These include animals such as deer, bear, elk, bobcats and mountain lions.

Biological Opinion: A document that states the opinion of the U.S.D.I. Fish and Wildlife Service as to whether or not the federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

BLM: Bureau of Land Management - The agency of the United States Government, under the Department of the Interior, responsible for administering certain public lands of the United States.

Bond: A sum of money which, under contract, one party pays another party under conditions that when certain obligations or acts are met, the money is then returned; such as after mining reclamation occurs. Also referred to as performance security. See "reclamation guarantee".

BTU: British Thermal Unit - The amount of heat required to raise the temperature of one pound of water one degree Fahrenheit.

C

Coal exploration: The field gathering of surface or subsurface geologic, physical, or chemical data by mapping, trenching, drilling, geophysical, or other techniques necessary to determine the quality and quantity of coal in an area.

Coal waste rock: Waste rock is the non-coal material that is removed while mining. It contains no coal or coal below the economic cutoff level, and must be removed as part of mining.

Capability: The potential of an area of land to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices at a given level of management intensity. Capability depends upon current conditions and site conditions such as climate, slope, landform, soils, and geology, as well as the application of management practices.

CEQ: Council on Environmental Quality - An advisory council to the President of the United States; established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

CFR: Code of Federal Regulations - A codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.

Cfs: Cubic feet per second - 1 cfs equals 448.33 gallons per minute.

Colluvium: Soil material or rock fragments moved down slope by gravitational force in the form of creep, slides, and local wash.

Concern: A point, matter, or questions raised by management or the public that must be addressed in the planning process.

Crucial winter range: those areas which, during the winter months, determine a population's ability to maintain and reproduce itself at a certain level over the long-term.

Cultural resources: The remains of sites, structures, or objects used by humans in the past, historic or prehistoric. More recently referred to as heritage resources.

Cumulative effects or impacts: Cumulative effect or impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taken place over a period of time (40 CFR 1508.7 - these regulations use effects and impacts synonymously). For example, the impacts of a proposed timber sale and the development of a mine together result in cumulative impacts.

D

dB: Decibel scale.

dBA: Decibel - A unit for expressing the relative intensity (loudness) of sound (decibel or dBA), weighted along the audible frequencies.

DBH: Diameter of a tree at breast height (four feet, six inches from ground level).

Decision-makers: The agencies, or designated representatives within the agencies, who must make the final decisions based upon the information presented in this Environmental Impact Statement.

Decommissioning: Suspension and/or closure of operations and possible removal of facilities.

Demography: A statistical study of the characteristics of human populations with reference to size, density, growth, distribution, migration, and effect on social and economic conditions.

Density: The number of individuals in a given area. Expressed per unit area.

Deposit: A natural accumulation, such as precious metals, minerals, coal, gas, oil, etc. that may be pursued for its intrinsic value; coal deposit.

Detection limit: The lowest concentration of a chemical that can be reliably reported to be different from zero concentration. Various analytical instrumentation has different detection limits.

Dewatering: To remove water from the coal seam.

Dilution: The act of mixing or thinning, and therefore decreasing a certain strength or concentration.

Dip: The angle at which rock stratum, veining, or any plane (fault) is inclined from a horizontal plane.

Direct impacts: Impacts which are caused by the action and occur at the same time and place.

Discharge: The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second, million gallons per day, gallons per minute, or cubic meters per second.

Diversion: Removing water from its natural course or location, or controlling water in its natural course or location, by means of a ditch, canal, flume, reservoir, bypass, pipeline, conduit, well, pump, or other structure or device.

Draft EIS: The draft state of environmental effects which is required for major federal actions under Section 102 of the National Environmental Policy Act, and released to the public and other agencies for comment and review.

Drilling: Exploratory action conducted to gather subsurface geologic, physical, or chemical data to determine the location, quantity, or quality of the natural mineral deposit of an area, including holes drilled for use as water wells.

E

EA: Environmental Assessment.

Effects: "Effect" and "impact" are synonymous as used in this document. Environmental changes resulting from a proposed action. Included are direct effects, which are caused by the action and occur at the same time and place, and indirect effects, which are caused by the action and are later in time or further removed in distance, but which are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.

EIS: Environmental Impact Statement - An analytical document prepared under the National Environmental Policy Act that portrays potential impacts to the environment of a proposed action and its possible alternatives. An EIS is developed for use by decision-makers to weigh the environmental consequences of a potential decision.

Employment: Labor input into a production process, measured in the number of person-years or jobs. A person-year is approximately 2,000 working hours by one person working year long or by several persons working seasonally. The number of jobs required to produce the output of each sector. A job may be one week, one month, or one year.

Endangered species: Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior or endangered in accordance with the 1973 Endangered Species Act.

Environment: The physical conditions that exist within the area that will be affected by a proposed project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance. The sum of all external conditions that affect an organism or community to influence its development or existence.

EPA: Environmental Protection Agency - An agency of the Executive Branch of the Federal Government which has responsibility for environmental matters of national concern.

Ephemeral stream: A stream or portion of a stream that flows only in direct response to precipitation or snow melt. Such flow is usually of short duration.

Erosion: The wearing away of the land surface by running water, wind, ice, or other geologic agents, including gravitation creep.

Exploration: The search for economic deposits of minerals, gas, oil or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking, and/or mapping.

F

Fault: Displacement of rock along a sheer surface or liner plane.

Feasible: Capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

Feasibility Study: As applied to mining, the feasibility study follows discovery of the mineral and is prepared by the mining company or an independent consultant. Its purpose is to analyze the rate of monetary return that can be expected from the mine at a certain rate of production. Based on this study, the decision by the company to develop the ore body may be made.

Final EIS: Means a detailed written statement as required by Section 12(2)(C) of the National Environmental Policy Act (40 CFR 1508.11). It is a revision of the Draft Environmental Impact Statement to include public and agency comments to the draft.

Fisheries habitat: Streams, lakes, and reservoirs that support fish populations.

Fishery: All activities related to human harvest of a fisheries resource.

Forest Plan: Each of the National Forests administered by the Forest Service is operated under a "Land and Resource Management Plan" as required by the National Forest Management Act of 1976. The 1976 Act was an amendment to the Multiple Use Sustained Yield Act of 1960 and the Forest and Rangeland Renewable Resources Planning Act of 1974. Forest Plans are prepared under the authority of these acts.

Forest Service: An agency of the United States, under the Department of Agriculture, responsible for administering certain public lands (Forest System Lands) of the United States.

Fugitive dust: Dust particles suspended randomly in the air, usually from road travel, excavation, and/or rock loading operations.

G

Game species: Any species of wildlife or fish for which seasons and bag limits have been prescribed and which are normally harvested by hunters, trappers, and fishermen under state or federal laws, codes and regulations.

Geohydrology: Refers to the hydrologic or flow characteristics of subsurface waters. Often interchangeable with hydrogeology.

Geotechnical engineering: A branch of engineering that is essentially concerned with the engineering design aspects of slope stability, settlement, earth pressures, bearing capacity, seepage control, and erosion.

GMUG: Grand Mesa, Uncompahgre and Gunnison.

Gpd, gph, gpm: Gallons per day, gallons per hour, gallons per minute.

Groundwater: Water found beneath the land surface in the zone of saturation below the water table.

Growth media: All materials, including topsoil, specified soil horizons, vegetative debris, and organic water, which are classified as suitable for stockpiling and/or reclamation.

Guidelines: An indication or outline of policy or conduct; (i.e., any issuance that assists in determining the course of direction to be taken in any planned action to accomplish a specific objective.

H

Habitat: The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions. The place where an organism lives.

Habitat capability: The estimated ability of an area, given existing or predicted habitat conditions, to support a wildlife, fish or plant population. It is measured in terms of potential population numbers.

Haul road: A road used by large (typically off-highway) trucks to haul ore and overburden from a mine to other locations, such as a mill facility or waste rock disposal area.

Hydraulic conductivity: A measure of the ability of rock or soil to permit the flow of groundwater under a pressure gradient; permeability.

Hydrologic system: All physical factors, such as precipitation, stream flow, snowmelt, groundwater, etc., that effect the hydrology of a specific area.

I

ID Team: Interdisciplinary Team - The interdisciplinary team is comprised of a group of personnel with different training, assembled to solve a problem or perform a task. The team will consider problems collectively, rather than separate concerns along disciplinary lines. This interaction is intended to insure systematic, integrated consideration of physical, biological, economic, environmental design arts and sciences.

Impermeable: Property of a substance that inhibits passage of fluids through its mass.

IMPLAN: Impact Analysis for Planning - A comprehensive and detailed database covering the entire United States, broken down by county and in some cases down to zip code level. IMPLAN is primarily used for assessing potential impacts to a community due to changes in the local economy. Originally developed through a cooperative between the U.S.D.A. Forest Service, Federal Emergency Management Agency, BLM, and the University of Minnesota. Currently, the database is maintained in Minnesota IMPLAN Group, Inc.

Impoundment: The collection and confinement of water in a reservoir or other storage area.

Increment: The amount of change from an existing concentration or amount; such as air pollutant concentrations.

Indirect Impacts: Impacts which are caused by the action but are later in time or farther removed in distance, although still reasonably foreseeable.

Infiltration: The movement of water or some other fluid into the soil through pores or other openings.

Informal consultation: An optional process that includes all discussions, correspondence, etc. between the U.S.D.I. Fish and Wildlife Service and another federal agency or the designated non-federal representative prior to formal consultation, if required.

Infrastructure: The underlying foundation or basic framework; substructure of a community (i.e., schools, police, fire services, hospitals, water and sewer systems).

Intermittent stream: A stream that runs water in most months, but does not contain water year-round.

Irretrievable: Applies primarily to the use of non-renewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Irreversible: Resource commitments that can not be reversed except perhaps in the extreme long term.

Issue: A point, matter, or question of public discussion or interest to be addressed or decided through a planning process.

J

Jeopardy or jeopardize the continued existence of: Means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. A jeopardy opinion would result in the U.S.D.I. Fish and Wildlife Service developing reasonable and prudent alternatives for the proposed action.

Jurisdictional wetland: A wetland area delineated and identified by specific technical criteria, field indicators and other information for purposes of public agency jurisdiction. The U.S. Army Corps of Engineers regulate "dredging and filling" activities associated with jurisdictional wetlands. Other federal agencies that can become involved with matters that concern jurisdictional wetlands include the U.S.D.I. Fish and Wildlife Service, the Environmental Protection Agency, and the Natural Resource Conservation Service.

K

L

Land management: The intentional process of planning, organizing, programming, coordinating, directing, and controlling land use actions.

Land Management Plan: See "Forest Plan."

Land status: The ownership status of lands.

LBA: Lease-by-application.

Lead agency: In NEPA (40 CFR 1501.5), the agency(s) with main responsibility for complying with NEPA procedural requirements, such as supervising the preparation of an Environmental Impact Statement.

Leaseable minerals: Minerals such as coal, oil shale, oil and gas, phosphate, potash, sodium, geothermal resources, and all other minerals that may be acquired under the Mineral Leasing Act of 1920, as amended.

Lease: A document through which interests are transferred from one party to another, subject to certain rights, obligations, and considerations.

Listed species: Species that are listed as threatened or endangered under the Endangered Species Act of 1973 (as amended).

Long-term impacts: Impacts that normally result in permanent changes to the environment. An example is a topographic change resulting from tailings disposal in a drainage. Each resource, by necessity, may vary in its definition of long-term.

Longwall mining system: A mining system which utilizes a shearing device with two rotating drums for cutting coal, a self-propelled hydraulic roof support, and a conveyor to continuously mine coal.

LRMP: Land and Resource Management Plan

M

Magazine: A storage facility for explosives. Magazines are built to specifications set by the Mine Safety and Health Administration and are usually located in a secure but remote area of a mine site.

Management activity: An activity of man imposed on a landscape for the purpose of harvesting, traversing, transporting, or replenishing natural resources.

Management area: An area with similar management objectives and a common management prescription.

Management direction: A statement of multiple use and other goals and objectives, and the associated management prescriptions, and standards and guidelines for attaining them (36 CFR 219.3).

Mean: A statistical value calculated by dividing the sum of a set of sample values by the number of samples. Also referred to as the arithmetic mean or average.

Mine facilities: Those structures and areas incidental to the operation of the mine, including mine offices, processing facilities, mineral stockpiles, storage facilities, shipping, loadout and repair facilities, and utility corridors.

Migratory: Moving from place to place, daily or seasonally.

Mitigation: Mitigation includes; (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance of operations during the life of the action; and, (e) compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20).

Monitoring and evaluation: A watching, observing or checking, in this instance, a testing of specific environmental parameters and of project waste streams for purposes of comparing with permit stipulations, pollution control regulations, mitigation plan goals, etc. The periodic evaluation of management practices on a sample basis to determine how well objectives have been met.

MOU: Memorandum of Understanding - Usually documenting an agreement reached amongst federal agencies.

MSHA: Mine Safety and Health Administration - Federal agency under the Department of Labor which regulates worker health and safety in mining operations.

Multiple use: The management concepts under which National Forest and BLM lands are managed. The management of the lands and their various resource values so they are utilized in the combination that will best meet the present and future needs of the American people.

N

NAAQS: National Ambient Air Quality Standards.

NADP: National Atmospheric Deposition Program.

National Forest Land Resource Management Plan: A plan which "...shall provide for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes long-term net public benefits in an environmentally sound manner." (36 CFR 219).

NEPA: An act declaring a national policy which encourages productive and enjoyable harmony between humankind and the environment, promotes efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and establishes a Council on Environmental Quality. (The Principal Laws Relating to Forest Service Activities, Agriculture Handbook No. 453, USDA, Forest Service, 359 pp).

NEPA process: Measures necessary to comply with the requirements of Section 2 and Title I of the National Environmental Policy Act.

NFMA: National Forest Management Act - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of Regional Guidelines and Forest Plans and the preparation of regulations to guide development on forest lands.

Non-game species: Animal species which are not hunted, fished, or trapped.

NO$_x$: Nitrogen oxides - A product of vehicle exhaust.

NPDES: National Pollutant Discharge Elimination System - A program authorized by Sections 318, 402 and 405 of the Clean Water Act, and implemented by regulations 40 CFR 122. NPDES program requires permits for the discharge of pollutants from any point source into Waters of the United States.

NRHP: National Register of Historic Places.

NSPS: New Source Performance Standards - Standards set by EPA defining the allowable pollutant discharge (air and water) and applicable pollution control for new facilities; by industrial category. (Clean Air Act and Clean Water Act)

O

Objective: A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals.

OSM: Office of Surface Mining Reclamation and Enforcement. An agency of the United States government within the Department of the Interior charged with regulating coal mining operations.

Overburden: Material of any nature that overlies a deposit of useful materials; waste earth and rock covering a coal or mineral deposit.

P

PAP: Permit application package.

Particulates: Small particles suspended in the air or generally considered pollutants.

Perennial stream: A stream that flows year-round.

Performance bond: See "reclamation guarantee."

Permeability: The property or capacity of a porous rock, sediment, or soil for transmitting a fluid; it is a measure of the relative ease of fluid flow under unequal pressure.

Permit area: The area of land and water within the boundaries of the approved permit or permits during the entire life of the operation and includes all affected lands and waters.

pH: Symbol for the negative common logarithm of the hydrogen ion concentration (acidity) of a solution. The pH of 7 is considered neutral. A pH number below 7 indicates acidity, and a pH value above 7 indicates alkalinity or a base.

Piezometer: A device for measuring moderate groundwater pressure.

Piezometric surface: Any imaginary surface coinciding with the hydraulic pressure level of the water in a confined aquifer, or the surface representing the static head of groundwater and defined by the level to which water will rise in a well. A water table is a particular piezometric surface.

Planning records: The body of information documenting the NEPA decisions and activities which result from the process of developing environmental documents; also known as an administrative record.

Plant communities: A vegetation complex unique in its combination of plants which occurs in particular locations under particular influences. A plant community is a reflection of integrated environmental influences on the site such as soils, temperature, elevation, solar radiation, slope aspects, and precipitation.

PM$_{10}$: Particulates of 10 microns in size or less, usually describing a source of air quality degradation.

Point source: Stationary sources of potential pollutants. In terms of mining, some examples of point sources are crushing and screening equipment, conveyor transfer points, and pond outlets.

Policy: A guiding principle upon which is based a specific decision or set of decisions.

Pollution: Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment producing undesired effects.

Portal: An underground coal mining term. A horizontal or nearly horizontal access opening into a coal mine. Different from a tunnel which has both ends opening to the surface.

Potable water: Suitable, safe, or prepared for drinking.

Potentiometric surface: Surface to which water in an aquifer would rise by hydrostatic pressure. (See "piezometric surface").

ppm: Parts per million.

Precipitation event: A quantity of water resulting from drizzle, rain, snow, sleet, or hail in a limited period of time. It may be expressed in terms of recurrence, interval, and duration.

Prehistoric: Relating to the times just preceding the period of recorded history.

Production rate: The quantity of coal mined in a given time period.

Project: The whole of an action, which has a potential for resulting in a physical change in the environment. An organized effort to achieve an objective identified by location, timing, activities, outputs, effects, and time period and responsibilities for executions.

Proposed action: A description of the project as proposed by a project proponent in a plan of operations.

PSD: Prevention of Significant Deterioration - A specific permit procedure established in the Clean Air Act, as amended, used to ensure that economic growth occurs in a manner consistent with the protection of public health; preservation of air quality related values in national special interest areas; the opportunity for informed public participation in the decision-making process.

Public land: Lands administered by the Bureau of Land Management, Forest Service, or other governmental agencies.

Public participation: Meetings, conferences, seminars, workshops, tours, written comments, responses to survey questionnaires, and similar activities designed and held to obtain comments from the public about planning.

336

Public scoping: Giving the public the opportunity for oral or written comments concerning the intentions, activity, or influence of a project on an individual, the community, and/or the environment.

Q

R

Raptor: Bird of prey, including eagles, hawks, falcons, and owls.

Reclamation: Returning disturbed land to a productive form, usually in conformity with a predetermined Land Management Plan or a government approved plan or permit.

Reclamation guarantee: A binding commitment payable to a government agency in the event that decommissioning and reclamation of an operation is not completed according to an approved plan or permit. See "bond."

Reclamation Plan: A document that details the measures to be taken by a project proponent (permit holder) to reclaim the project lands; such a document can contain reclamation measures to be employed during mining operations but typically describes measures to be used after mining and milling have been completed.

Resident: A species, which is found in a particular habitat for a particular time period (i.e., winter resident, summer resident, year-round) as opposed to those found only when passing through on migration.

Riparian: A type of ecological community that occurs adjacent to streams and rivers and is directly influenced by water. It is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water or conditions more moist than that normally found in the area.

Riparian zone: Terrestrial areas where the vegetation and microclimate are influenced by perennial and/or intermittent water, associated high water tables and soils which exhibit some wetness characteristics; this habitat is transitional between true bottom land wetlands and upland terrestrial habitats.

RMP: Resource Management Plan.

ROD: Record of Decision - A document separate from, but associated with, an Environmental Impact Statement which states the decision, identifies alternatives, specifying which were environmentally preferable, and states whether all practicable means to avoid environmental harm from the alternative have been adopted, and if not, why not (40 CFR 1505.2).

Room-and-Pillar Mining: A mining system that uses a continuous miner to excavate coal (rooms) leaving a rectangular pattern of coal (pillars) as roof support in the mine.

Runoff: Precipitation that is not retained on the site where it falls, not absorbed by the soil; natural drainage away from an area.

S

Safety factor: A safety factor is a ratio of resisting forces to driving forces. By determining a structure's safety factor, a numerical index of stability is obtained.

Scoping process: A part of the National Environmental Policy Act process; early and open activities used to determine the scope and significance of the issues, and the range of actions, alternatives, and impacts to be considered in an Environmental Impact Statement (40 CFR 1501.7).

Sediment: Each material transported, suspended, or deposited by water; also, the same material once it has been deposited.

Sedimentation pond: A sediment control structure designed, constructed, and maintained to slow down or impound precipitation runoff to reduce sediment concentrations in a point source discharge, including dams or excavated depressions. The term does not include straw dikes, riprap, check dams, mulches, collection ditches, toe ditches, vegetative buffers, gabions, contour furrows, and other traditional soil conservation techniques and non-point source runoff controls.

Sensitive species: Plant or animal species which are susceptible or vulnerable to activity impacts or habitat alterations. Those species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species, that are on an official state list, or that are recognized by the regional Forester as needing special management to prevent placement on federal or state lists.

Shaft: An underground coal mining term. A vertical or inclined passageway which connects two or more levels in a mine.

SHPO: State Historic Preservation Office.

Short-term impacts: Impacts occurring during project construction and operation, and normally ceasing upon project closure and reclamation. Each resource, by necessity, may vary in its definition of short-term.

Significant: Requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts. The severity of an impact should be weighted along with the likelihood of its occurrence.

SMCRA: Surface Mining Control and Reclamation Act.

SO_2: Sulfur oxides, including sulfur dioxide (SO_2). A product of vehicle tailpipe emissions.

Socioeconomic: Pertaining to, or signifying the combination or interaction of social and economic factors.

Soil horizon: A layer of soil material approximately parallel to the land surface differing from adjacent genetically related layers in physical, chemical, and biological properties.

Solid waste: Garbage, refuse, and/or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, agricultural, and community activities.

Sound level (dBA): The sound pressure level in decibels as measured on a sound level meter using the A-weighing filter network. The A-weighing filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the responses of the human ear and gives good correlation with subjective reactions to noise.

SPCC: Spill Prevention Control and Countermeasure Plan - A plan which the EPA requires having on file within six months of project inception. It is a contingency plan for avoidance of, containment of, and response to hazardous materials spills or leaks.

Standard: A model, example, or goal established by authority, custom, or general consent as a rule for the measurement of quantity, weight, extent, value, or quality.

Stream gradient: The rate of fall or loss of elevation over the physical length of a segment or total stream usually expressed in ft/ft (%).

Subsidence: A lowering of surface land caused by the collapse of rock and soil into an underground void.

Substantive comment: A comment that provides factual information, professional opinion, or informed judgement germane to the action being proposed.

T

TDS: Total Dissolved Solids - Any finely divided materials (with a diameter smaller than a few hundred micrometers) suspended in liquids such as water.

Terrestrial: Of or relating to the earth, soil, or land; an inhabitant of the earth or land.

Threatened species: Those plants or animal species likely to become endangered species throughout all or a significant potion of their range within the foreseeable future.

Third-party contractor: An independent firm, usually contracted by a government agency, to perform work related to a proposed action or another organization; due to the financial and contractual arrangements governing such relationships, the third-party contractor has no financial or other interest in the decision to be reached on the project.

Topography: A configuration of a surface including its relief, elevation, and the portion of its natural and human-created features.

tpd: Tons per day.

TPH: Total petroleum hydrocarbons.

TSP: Total Suspended Particulates - Any finely divided material (solid or liquid) that is airborne with an aerodynamic diameter smaller than a few hundred micrometers.

TSS: Total Suspended Solids - As it applies to sediments in streams.

Turbidity: Reduced water clarity resulting from the presence of suspended matter.

U

Unavoidable effects: Many effects which could occur from a project can be eliminated or minimized by management requirements and constraints and mitigation measures. Effects that cannot be eliminated are identified as unavoidable.

Underground coal mine: A subterranean excavation made for the purpose of extracting mineable coal.

USDA: United States Department of Agriculture.

USDI: United states Department of the Interior.

USFWS: United States Fish and Wildlife Service - United States Department of the Interior.

USGS: United States Geological Survey - United States Department of the Interior.

Understory: A foliage layer lying beneath and shaded by the main canopy of a forest.

V

W

Watershed: the entire land area that contributes water to a particular drainage system or stream.

Water quality: The interaction between various parameters that determines the usability or non-usability of water for on-site and downstream uses. Major parameters that affect water quality include: temperature, turbidity, suspended sediment, conductivity, dissolved oxygen, pH, specific ions, discharge, and fecal coliform.

Weathering: The process whereby larger particles of soils and rock are reduced to finer particles by wind, water, temperature changes, and plant and bacteria action.

Wetlands (Biological Wetlands): Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, etc. (See "jurisdictional wetlands").

Wilderness: Land designated by Congress as a component of the National Wilderness Preservation System.

Wind rose: A diagram showing the relative frequency of winds blowing from different directions.

X

Y

Z

10-year, 24-hour event: The precipitation that is predicted to occur during a 24-hour period with a 10-year recurrence interval.

25-year, 24-hour event: The precipitation that is predicted to occur during a 24-hour period with a 25-year recurrence interval.

404 Permit: Section 404 of the Clean Water Act specifies that anyone wishing to place dredge or fill materials into the Waters on the United States and adjacent jurisdictional wetlands shall apply to the U.S. Army Corps of Engineers for approval. A permit issued by the Corps of Engineers for these activities is known as a 404 permit.

Chapter 8

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Appendix A

Lease Tract Information

APPENDIX A
LEASE TRACT INFORMATION

ALTERNATIVE B

In August of 1997, Bowie Resources, Ltd.(Bowie) filed coal lease application COC-61209 (Iron Point Tract) requesting the Bureau of Land Management (BLM) offer federal coal for competitive lease. The Application was for the following lands:

T12S, R91W, 6th PM:
  Section 33, lots 1 to 16, inclusive, S½ N½;
  Section 34, lots 1 to 16, inclusive, S½ N½;
T13S, R91W, 6th PM
  Section 2, SW¼ NW¼, NW¼ SW¼, and E½ SW¼;
  Section 3, lots 1 to 4, inclusive, S½ N½, and N½ S½;
  Section 4, lots 1 to 4, inclusive, S½ N½, and S½;
  Section 5, S½ SE¼, and SE¼ SW¼;
  Section 8, NE¼;
  Section 9, NW¼, and N½ SW¼;
  Section 11, NE¼ NW¼.

Containing approximately 3,403.27 acres±, with an estimated 24 million tons of recoverable coal or 7,050 tons per acre. The coal resource within the Iron Point Tract is limited to coal recoverable by underground mining methods.

In December of 1997, Oxbow Mining Inc. filed coal lease application COC-61357 (Elk Creek Tract), requesting the BLM offer for competitive lease federal coal in the lands described as:

T12S, R90W, 6th PM:
  Section 31, lots 1 to 14, inclusive, and NE¼;
  Section 32, lots 3 to 6, inclusive, lots 11 to 14, inclusive, and NW¼.
T12S, R91W, 6th PM:
  Section 35, lots 1, 2, and 4 to 8, inclusive, 13 to 16, inclusive, lots 21, 22, and that part of HES No. 134 lying in the NE¼; .
  Section 36, lots 1 to 17, inclusive, NE¼, E½ NW¼, SW¼ NW¼, and that part of HES No. 134 lying in lot 1.
T13S, R90W, 6th PM:
  Section 5, lots 7 to 10, inclusive;
  Section 6, lots 8 to 17, inclusive.
T13S, R91W, 6th PM:
  Section 1, lots 1 to 4, inclusive, S½ NW¼ and SW¼;
  Section 2, lot 1, and S½ NE¼;
  Section 12, S½ NE¼, and NW¼.

Containing approximately 3,862.81 acres±, with approximately 21 million tons of recoverable coal or 5,436 tons per acre. The coal resource to be offered for lease is limited to coal recoverable by underground mining methods.

In May of 1998, Bowie filed a coal exploration license application (COC-61945), with the BLM. The Iron Point Exploration License contains unleased coal deposits owned by the United States of America in the following described lands in Delta County, Colorado.

T12S, R91W, 6th PM:
    Section 14, lots 7, 8, S½ S½, NE¼ SW¼, NW¼ SE¼;
    Section 22, S½;
    Section 23, lots 1 to 7, inclusive, W½, and that part of HES No. 133 lying in the S½ SE¼;
    Section 26, lots 1 to 5, inclusive, W½, N1/2SE¼, and that part of HES No. 133 lying in the NE¼;
    Section 27, all;
    Section 28, S½;
    Section 29, SE¼;
    Section 32, lots 1, 2, 7 to 10, inclusive, lots 15, 16, and NE¼;
    Section 33, lots 1 to 16, inclusive, and N½;
    Section 34, lots 1 to 16, inclusive, and N½;
    Section 35, lots 3, and 7 to 22, inclusive, NE¼ NW¼, W½ NW¼, that part of HES No. 134 and that part of lots 4 to 6, inclusive, lying in the S½ S½ NE¼.

Containing approximately 6,053.00 acres±.

These applications encompass federal coal on BLM and Gunnison National Forest lands. Additions and/or deletions to the delineated tracts may be considered as alternatives to Alternative B. Alternatives would be developed and analyzed based on issues and management needs.

ALTERNATIVE C

Add to the Iron Point Tract the following description:

T13S, R91W, 6th PM
    Section 5, lots 11, 12, SW¼ NE¼, SE¼ NW¼, NE¼ SW¼, N½ SE¼ containing approximately 240 acres. It is estimated that there are 11,750 tons of recoverable coal per acre (42.8 million tons).

Add to the Elk Creek Tract the following description:

T12S, R91W, 6th PM:
    Section 35, lots 3, 9 to 12, inclusive, lots 17 to 20, inclusive, N½ NW¼, and SW¼ NW¼.

Containing approximately 433.78 acres. It is estimated that there are 5,375 tons of recoverable coal per acre (23.1 million tons).

ALTERNATIVE D

The acreage for both the Iron Point and Elk Creek Tracts remains the same as Alternative C. It is estimated that there are 11,225 tons of recoverable coal per acre (40.9 million tons) on the

Iron Point Tract and 5,375 tons of recoverable coal per acre (23.1 million tons) on the Elk Creek Tract.

SURFACE OWNERSHIP

The surface ownership of the lands is shown on Figure 2, Surface Ownership Map. All the acreage described above contains federally managed minerals. Approximately 1,714 acres are privately owned surface, 6,842 acres are managed by the Forest Service, and 3,090 acres are managed by the BLM.

Appendix B

Agency Jurisdiction (Permits and Approvals)

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APPENDIX B
AGENCY JURISDICTIONS (PERMITS AND APPROVALS)

A number of federal, state, and local permits and approvals are or could be required for the exploration and mining of the Iron Point and Elk Creek Tracts. See *Table B-1, List of Permits and Approvals*. Many of the listed permits are required at the mine permit stage not the leasing stage. They are included here to give the reader a more complete picture of the coal permitting process.

Preparation of an Environmental Impact Statement (EIS) and the actual permitting processes are related but distinctively separate. An EIS is designed to explore alternatives and discuss environmental impacts. The permitting or approval processes give individual government decision makers the authority to grant, conditionally grant, or deny individual permit applications. Permits may be granted with requirements and conditions to eliminate and/or mitigate specific adverse impacts pursuant to their individual regulations and guidelines.

1.0 BUREAU OF LAND MANAGEMENT

For the North Fork Coal EIS, the BLM is serving as a joint lead agency in the EIS process with the Forest Service. The BLM will follow a specific procedure that began with scoping and data collection which will result in the assessment and analysis of alternatives. The results of the environmental analyses are documented in the EIS and will form the basis for the Colorado State Director of the BLM in making a decision on leasing and exploration.

The BLM responsibilities include the following:

- Competitive coal leasing;
- Resource recovery and protection plans; and,
- Special use permits.

1.1 Competitive Coal Leasing

In response to the competitive coal lease applications, or LBAs, submitted by Bowie for the Iron Point Tract (COC-61209) and by Oxbow for the Elk Creek Tract (COC-61385), the BLM will process these coal lease applications in accordance with the regulations found at 43 CFR 3420. In conjunction with the Forest Service, the BLM will prepare an EIS to analyze potential impacts of the proposed leasing and reasonably foreseeable mining actions, as well as develop mitigating measures to be included as lease stipulations in the event a competitive sale is held.

The BLM will conduct a public hearing before a competitive sale is held to allow public comment on the effects of mining on the proposed lease. The BLM must also evaluate lease proposals with respect to coal unsuitability criteria developed by the Department of the Interior. This evaluation has been completed in conjunction with the BLM-Uncompahgre Basin Resource Management Plan (1989) and the Forest Service Land and Resource Management Plan for the Grand Mesa, Uncompahgre and Gunnison National Forests, as amended (September 1991). The criteria has also been reviewed for implications with the other alternatives in this analysis. In addition, data adequacy standards were reviewed and determined to be adequate.

Table B-1
List of Permits and Approvals

Federal Government	
Bureau of Land Management	• Lease Issuance and Administration • Mine Permit Concurrence • Resource Recovery and Protection Plans (R2P2) Approval • Special Use Permits (right-of-ways, etc.) • Approve Exploration License
Forest Service	• Consent to Lease • Mine Permit Consent/Concurrence • Special Use Permits (road use) • Consent and Prescribe Use for Exploration License
Office of Surface Mining	• Mine Permit Approval (Mineral Leasing Act)
U.S. Department of the Interior	• Mining Permit Plan Approval (Mineral Leasing Act
U.S. Army Corps of Engineers	• Section 404 Permit
Environmental Protection Agency	• Spill Prevention Control and Countermeasure (SPCC) Plan • Review of Section 404 Permit • Notification of Hazardous Waste Activity
U.S. Fish and Wildlife Service	• Threatened and Endangered Species Consultation
Treasury Department (Department of Alcohol, Tobacco, and Firearms)	• Explosives User Permit
Mine Safety and Health Administration	• Mine Identification Number • Legal Identify Report • Miner Training Plan Approval • Ventilation Plan Approval • Ground Control Plan
State of Colorado	
Colorado Department of Minerals and Geology	• Exploration Permit • Mining and Reclamation Permit
Colorado Air Pollution Control Division	• Permit to Construct • Permit to Operate
Colorado Water Quality Control Division	• Storm Water Discharge Permit • National Pollutant Discharge Elimination System (NPDES)
Colorado State Engineer	• Water Rights • Water Well Permits • Dam Safety Permits
Colorado State Historic Preservation Office	• Historic and Archaeological Review
Colorado Department [illegible] Transportation	• Highway Access
Local Government	
Delta County	• Building Permit
Gunnison County	• Land Use Change Permit • Building Permit

Following the completion of the EIS, the Montrose District Office of the BLM will forward the competitive lease application, the North Fork Coal EIS, a Maximum Economic Recovery report (MER), a proposed Record of Decision, proposed lease terms and conditions, and preliminary recommendations for each lease tract to the Colorado State Director of the BLM in Denver. The Colorado State Director will make a determination on leasing action, the proposed lease terms and conditions, and the bonding requirements. The Colorado State Director will then prepare newspaper and *Federal Register* notices of the sale and post such notices of the proposed sales in the Public Room at the state office of the BLM. A sales panel consisting of the Deputy State Director for Mineral Resources, a BLM mining engineer, a BLM geologist, and a BLM mineral economist will then be designated as the group that will analyze prospective bidders and make recommendations regarding bids received at the proposed lease sale.

1.2 Exploration License

An exploration license is processed in much the same way as a lease application. The BLM will process Bowie's Iron Point Exploration License application, COC-61945 in accordance with the regulations in 43 CFR 3400. In conjunction with the Forest Service, the BLM will use this EIS to analyze potential impacts and develop mitigating measures to be included as stipulations in the event a license is issued.

Following the completion of the EIS, the Uncompahgre Field Office of the BLM will forward preliminary recommendations and any proposed terms and conditions to the Colorado State Director in Denver. The Colorado State Director will then make a determination, consistent with the Forest Service's recommendations under the consent provisions (see Section 2.0, Forest Service), on the issuance of the exploration license.

1.3 Resource Recovery and Protection Plans (R2P2)

If a lease is issued, prior to any lease development, the lessee or operator must file a Resource Recovery and Protection Plan (R2P2) with the BLM to comply with 43 CFR 3482. This plan contains detailed information regarding the coal seams within the lease boundaries and requires the lessee and/or the operator to submit detailed mining plans regarding the coal to be mined. It is the responsibility of the BLM to ensure that the coal resources within the lease will be appropriately mined such that maximum coal recovery can be achieved. The purpose of the R2P2 is to ensure that the federal government receives the maximum royalties from the resource within the lease boundaries, and that the recovery of the coal resource is accomplished so as to minimize the loss of any coal resource for future extraction.

1.4 Special Use Permits

On public lands administered by the BLM, the agency has review and approval authority for any project related right-of-ways such as access roads. The BLM will be responsible for issuing special use permits for these type of activities.

2.0 FOREST SERVICE JURISDICTION

For the North Fork Coal EIS, the Forest Service is serving as a joint lead agency in the EIS process with the BLM. With this responsibility, the Forest Service will work with the BLM throughout the EIS process.

The Forest Service was granted consent authority with regard to the issuance of coal leases and licenses with the passage of the Federal Coal Leasing Amendment Act of 1976. Under this act, a coal lease or license may not be issued without consent of the surface managing agency, (i.e., the Forest Service in the case of the Iron Point and Elk Creek Coal Lease Tracts), and not without including conditions (stipulations) upon which consent is given. Under 43 CFR 3420.4-2(a) it is stated:

> *The Secretary of the Interior, for any proposed lease tract containing lands the surface of which is under the jurisdiction of any agency other than the department (of the interior), shall request that that agency: (1) consent, if it has not already done so, to the issuance of the lease (43 CFR 3400.3-1), and (2) if it consents, prescribe the terms and conditions the Secretary will impose in any lease which the head of the agency requires for the use and protection of non-mineral interests in those lands.*

Under the Forest Service Manual Chapter 2820, R2 supplement No. 2800-94-1, 2822.04(c), the Regional Forester of the Rocky Mountain Region has delegated the authority to sign all decision documents for mineral leases (consent to leases) to the Forest Supervisor. In the case of the North Fork Coal EIS, the Forest Supervisor of the Grand Mesa, Uncompahgre, and Gunnison National Forests will be the responsible official for any decisions regarding the Iron Point Coal Lease Tract, the Elk Creek Coal Lease Tract, and the exploration license area within and surrounding the Iron Point Tract.

Regarding any specific ground disturbing activities on forest lands, the Forest Service is responsible for the oversight of such activities, and the agency may require a reclamation performance security (i.e., reclamation bond), prior to allowing any ground disturbing activities on forest lands.

Similar to the BLM, on any public lands administered by the Forest Service, the agency has review and approval authority for any project related right-of-ways, access roads, dam or dike construction, etc. In these instances, the Forest Service would require a Special Use Permit from the lessee or the operator on Forest Service administered lands.

3.0 OFFICE OF SURFACE MINING JURISDICTIONS

The OSM is a cooperating agency with the BLM and the Forest Service on the North Fork Coal EIS. As such, OSM has provided input into the North Fork Coal EIS process.

The Surface Mining Control and Reclamation Act (SMCRA), gives OSM primary responsibility to administer programs that regulate surface coal mining operations on federal lands and the surface effects of underground coal mining operations on federal lands.

Pursuant to Section 503 of SMCRA, the Colorado DMG developed, and the Secretary of the Department of the Interior approved, a permanent program authorizing the Colorado DMG to regulate surface coal mining operations and surface effects of underground coal mining on non-federal lands within the state of Colorado. In September of 1982, pursuant to Section 523(c) of SMCRA, the Colorado DMG entered into a cooperative agreement with the Secretary of the Department of the Interior authorizing the Colorado DMG to regulate surface coal mining operations and the surface effects of underground mining on federal lands within the state of Colorado.

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Pursuant to that cooperative agreement, federal coal lease holders in Colorado must submit permit applications to both the OSM and the Colorado DMG for proposed mining and reclamation operations on lands in the state of Colorado. The Colorado DMG will review the permit application packages to ensure that the permit application complies with their permitting requirements and that the coal mining operation will meet the approved permanent regulatory program's performance standards. If the permit application package complies with the applicable regulations and performance standards, the Colorado DMG will issue the lessee or operator a permit to conduct coal mining and reclamation operations on the subject lease.

The public has the opportunity to provide comments to the Colorado DMG and request an informal conference or a public hearing on each permit application package. These opportunities for comment are published as legal notices in a local newspaper of general circulation.

The OSM, Forest Service, BLM, and other appropriate federal agencies will review the permit application package to ensure that it complies with the terms of the coal lease, the requirements of the Mineral Leasing Act of 1920 ("MLA"), the National Environmental Policy Act of 1969 ("NEPA"), and other federal laws and their attendant regulations.

The OSM will recommend approval, approval with conditions, or disapproval of any MLA mining and reclamation plan involving federal coal to the Assistant Secretary of the Department of the Interior - Lands and Minerals Management. Before the mining plan can be approved, the BLM, Forest Service and a surface-managing agency, if other than the BLM or Forest Service, must concur with this recommendation.

The Colorado DMG enforces the performance standards and permit requirements during the operation of the mine and have primary authority in environmental emergencies. The OSM retains oversight responsibility for this enforcement. The BLM has authority in those emergency situations where the Colorado DMG or OSM inspectors can not act before environmental harm or damage occurs.

The information and data submitted in the coal lease applications by Bowie and Oxbow do not constitute a formal underground mining permit application package to either the OSM or the Colorado DMG. This coal lease application information has been used solely to develop an impact analysis in the EIS. Its use is intended to illustrate one possible plan for developing federal coal reserves on the lease tracts and does not imply that either Bowie or Oxbow would be given any preference in the event that lease sales are held. In addition, such information does not imply that the permit application package developed from these preliminary plans would comply with the regulations or be approved by the Colorado DMG if a lease sale were held and Bowie or Oxbow obtained the respective lease tracts for which they are applying. Any plan which is ultimately submitted must comply with the regulations of the Colorado DMG and the OSM before such plan can be approved.

4.0 MINERALS MANAGEMENT SERVICE

The Minerals Management Service has no permitting responsibilities associated with coal mining. However, this organization is an important government agency with its primary function focused at collecting royalties from the mining of coal on federal lands. The Mineral Management Service regularly works with the BLM regarding mining on federal coal lease tracts and reviews mine maps and other documentation in order to assess the coal tonnages extracted from the federal coal lease. In addition, the Mineral Management Service will review coal sales records of the lessee or operator to ensure that the federal government receives the appropriate royalty amount from the extracted federal coal. For surface mines, the royalty for federal coal is 12.5% of the sales price of the coal at the mine site; for underground coal mining operations the royalty is 8% of the sales price at the mine site.

5.0 U.S. ARMY CORPS OF ENGINEERS

The Corps of Engineers is responsible for issuing permits under Section 404 of the Clean Water Act which requires permits for the "discharge of dredged or fill material into navigable waters." Guidelines promulgated by the Environmental Protection Agency (EPA) under Section 404(b)(1) generally prohibit the discharge of dredged or fill materials into "Waters of the United States" unless it can be shown that the discharge is the least environmentally damaging practicable alternative to achieve the basic purpose of the proposed project.

The term "Waters of the United States" is broadly defined as waters that are or could be used in interstate or foreign commerce. In addition to territorial seas and interstate waters, this includes other waters such as lakes, mud flats, sloughs, and wetlands which are or could be used in interstate or foreign commerce. To the degree that they impact "Waters of the United States," various activities associated with mining operations, such as road or bridge construction, mine portal site development and construction, construction of water storage dams, etc., may require a Section 404 Permit.

The Corps of Engineers must comply with Executive Orders 11990 and 11998 with respect to impacts to the nations wetlands and/or floodplains. The "no net loss" wetlands policy is outlined in an agreement between Corps of Engineers and the EPA. The policy goal of the no net loss to wetland acreage or function is implemented primarily through permit review.

In reviewing Section 404 permit applications, the Corps of Engineers must evaluate whether the benefits from the project outweigh the predicted environmental impacts. This is called a "public interest review." Factors considered during the public interest review include the following:

- Basic project purpose and need;
- Water dependency;
- Availability of practicable alternatives, taking into consideration cost, logistics, and technology; and,
- Environmental impacts.

The Corps of Engineers evaluates whether the proposal is the least environmentally damaging practicable alternative. It may be necessary for the applicant to include mitigation measures that will reduce impacts to the aquatic environment to an acceptable level. These measures may include avoiding fills to "Waters of the United States", reducing the area of fill, creating or restoring aquatic environments, and/or enhancing the value of an existing aquatic area.

6.0 ENVIRONMENTAL PROTECTION AGENCY

NEPA documents, such as the draft EIS, the final EIS, and Records of Decision completed by the BLM and Forest Service for the lease tracts regarding the North Fork Coal EIS, will be filed with the EPA.

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In addition to its NEPA oversight responsibilities, the EPA has responsibilities involved with the following:

- Clean Water Act; and
- Clean Air Act.

6.1 Clean Water Act

The Clean Water Act has established the following surface water programs which may concern mining operations of either Bowie or Oxbow in the Iron Point and Elk Creek Coal Lease Tracts:

- The NPDES permit program regulating the point source and storm water discharge of pollutants;
- The Section 404 permit program regulating the discharge of dredged or fill material; and,
- The Section 311 program regulating spills of oil and hazardous substances.

EPA established the National Pollutant Discharge Elimination System (NPDES) program for regulating surface water quality. This program was principally established by the Federal Water Pollution Control Act Amendments of 1972 and supplement amendments and re-authorization. In its amended and re-authorized form, this statute as a whole is now generally referred to as the Clean Water Act.

The NPDES permit program is established by Section 402 of the Clean Water Act. The Colorado Department of Public Health and Environment is the permitting authority in the state of Colorado for the issuance of NPDES permits pursuant to Section 402 of the Clean Water Act.

Section 404 of the Clean Water Act authorizes the Corps of Engineers to issue permits "for the discharge of dredged or fill materials into navigable waters." These permits are addressed under 14.5, U.S. Army Corps of Engineers Responsibilities, which immediately proceeds this discussion. The EPA is responsible for reviewing the consistency of any proposed 404 action with Section 404(b)(1) guidelines.

Section 311 of the Clean Water Act establishes requirements relating to discharges or spills of oil or hazardous substances. Discharges or spills of oil in "harmful quantities" are prohibited. The EPA has established a requirement for the preparation of a Spill Prevention Control and Countermeasure (SPCC) plan by facilities that handle substantial quantities of oil.

6.2 Clean Air Act

In addition to water quality oversight, the EPA also maintains control over the air resources of an area as outlined in the Clean Air Act. The Clean Air Act's most basic goals are to protect public health and welfare. The EPA can comment on, but is not responsible for, a new source (air quality) construction permit issued by the Colorado Department of Public Health and Environment.

7.0 U.S. FISH AND WILDLIFE SERVICE

The U.S. Fish and Wildlife Service administers the Endangered Species Act, as re-enacted in 1982, and the Bald Eagle Protection Act of 1940, as amended. On the North Fork Coal EIS, the BLM and Forest Service consulted with the U.S. Fish and Wildlife Service regarding any federally listed threatened or endangered species that might be impacted by proposed operations. This is known as the Section 7 Consultation. A biological assessment (BA) has been prepared by the BLM and Forest Service for any federally listed threatened or endangered species, and this document has been submitted to the U.S. Fish and Wildlife Service. If adverse impacts to threatened or endangered species are projected, specific design measures to protect the affected species may need to be developed.

8.0 U.S. MINE SAFETY AND HEALTH ADMINISTRATION

The health and safety aspects of Bowie and Oxbow operations are regulated by federal health and safety standards for mining operations. MSHA makes comprehensive routine inspections of the underground coal mining operations and are involved in educational and safety training programs for company personnel. Underground coal mining operators are also responsible for providing MSHA with reports of accidents, injuries, occupational diseases and related data. Specific programs for the education and training of all underground coal mining employees are also a part of the health and safety regulations of MSHA. MSHA also reviews and approves ventilation plans and ground control plans for underground coal mines.

9.0 TREASURY DEPARTMENT (DEPARTMENT OF ALCOHOL, TOBACCO AND FIREARMS)

Intrerstate transportation of explosives is regulated by the Department of Alcohol, Tobacco and Firearms. Underground coal mining operators or their explosives suppliers will need to obtain a license for transport of such explosives to the site. In addition, an explosive user permit will also be required by this agency.

10.0 ADVISORY COUNCIL ON HISTORIC PRESERVATION

A copy of both the Draft EIS and Final EIS documents must be filed with the Advisory Council on Historic Preservation. This agency works in an advisory role to assist the BLM and Forest Service with compliance with the National Historic Preservation Act and the American Indian Religious Freedom Act. In addition, the Colorado State Historic Preservation Office will give concurrence with any agency determined cultural impacts. The Advisory Council on Historic Preservation would be available to serve in an advisory role if requested by the Colorado agency. The Advisory Council on Historic Preservation may also review state program activities and determine relative compliance to the previously mentioned National Historic Preservation Act.

11.0 COLORADO DEPARTMENT OF MINERALS AND GEOLOGY

Under the Colorado Surface Coal Mining Reclamation Act (34-33-101 et. seq., CRS 1973, as amended) and the regulations of the Coal Mined Land Reclamation Board for coal mining (1980, amended), the Colorado DMG requires a permit to regulate surface coal mining activities and the surface effects of underground coal mining. The purpose of this permitting program is to ensure the disturbed areas are reclaimed and environmental protection is ensured for coal mining activities within the state of Colorado. Performance security for reclamation activities is required before this permit is granted.

The Colorado DMG requires engineering information for coal mining operations including topographic maps, sequence of mining, coal waste disposal sites, borrow sites, construction methods, equipment to be used, plans for mitigation of runoff and erosion, sediment control measures, and the proposed methods and schedule of reclamation. Environmental information includes soil characterization and topsoil management, erosion control measures, reclamation and revegetation plans and methods to protect ground and surface water quality.

In addition, the Colorado DMG has permitting requirements for coal exploration activities. Such permitting activities require a description of the planned exploration, the methods and schedule for reclamation and environmental protection measures to be employed during exploration.

12.0 COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT AIR POLLUTION CONTROL DIVISION

The Colorado Department of Public Health and Environment - Air Pollution Control Division has review and approval authority over new source construction or additions or modifications to existing sources for releasing contaminants into the air. The Air Pollution Control Division has regulatory responsibility for the following permits which may affect mining operations:

- Permit to Construct;
- Permit to Operate; and,
- Prevention of Significant Deterioration.

12.1 Permit to Construct

This permit requires the applicant to submit an emissions inventory listing sources and amounts of air pollution released, an analysis of best available control technology (BACT), and a demonstration that ambient air quality standards, including levels for toxic air pollutants will not be exceeded. The statutory authority for new source construction approval is the Colorado Clean Air Act and subsequent regulations.

12.2 Permit to Operate

The Colorado Air Pollution Control Division has a comprehensive air operating permit program which is consistent with the requirements of Title V of the Federal Clean Air Act. Facilities will be required to obtain operating permits within six months of the issuance of initiation of construction activities.

12.3 Prevention of Significant Deterioration (PSD)

The basic objective of the prevention of significant deterioration (PSD) air quality program is to prevent substantial degradation of air quality in areas that are in compliance with national ambient air quality standards, while maintaining a margin for future growth. As part of the new source review, PSD applicability is determined.

Criteria that trigger the requirements for a PSD permit vary depending on the type of facility. In the case of mining, a PSD permit is not required for operations that emit less than 250 tons per year of any pollutant regulated under the Federal Clean Air Act. Pollutants can include both particulate (dust) and gaseous SO_2, CO_2, NO_x and HC emissions.

Specific information on PSD requirements can be found in 40 CFR 52.221 as adopted. If a PSD permit is required, one year of site-specific ambient air quality data collected by the applicant is typically needed.

13.0 COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT - WATER QUALITY CONTROL DIVISION

Under authority delegated by the EPA, the Colorado Department of Public Health and Environment - Water Quality Control Division regulates the discharge of pollutants into Colorado's surface waters through the NPDES permit (see Section 14.6.1, Clean Water Act, of this document).

An application for an individual NPDES permit requires information on water supply volumes, water utilization, waste water flow characteristics and disposal methods, planned improvements, storm water treatment, plant operation, materials and chemical used, production, and other related information. Depending on the type of materials to be mined, the EPA regulations may specify effluent limitations for inclusion in an NPDES permit for the discharge of waste waters and storm water. Mines for which EPA has not promulgated storm water effluent limits are required to obtain coverage under a general storm water permit issued by the Colorado Water Quality Control Division. Processing time for an individual NPDES permit ranges from about 180 days to 1 year, but varies upon project complexity. A public hearing on a proposed NPDES permit may be required.

14.0 COLORADO STATE ENGINEER'S OFFICE

The Colorado State Engineer has oversight responsibility for the following permits:

- Dam Safety Permit; and,
- Permit to Appropriate Public Waters.

14.1 Dam Safety Permit

The Colorado State Engineer requires approval for any person or entity intending to construct, modify, or repair any dam or control works for a dam or dike that will store water to a depth of 10 or more feet at its deepest point or a dam or dike that will contain 10 or more acre-feet of water. Reservoir applications require information on the use and capacity of the reservoir and a legal description of the location of the structure.

Before beginning any construction, plans and specifications must be prepared by a properly qualified Colorado state certified professional engineer (carrying the engineer's signature and seal) and submitted for approval to the Colorado State Engineer. Plan approval is required before beginning construction.

The Colorado State Engineer's office is also required to periodically inspect the construction and operation of any dams in order to secure safety to life and property.

14.2 Permit to Appropriate Public Waters

Authority to use public water is granted through issuance of a permit to appropriate public waters from the Colorado State Engineer's office.

A permit is required prior to the development of any diversion of surface water and/or withdrawal of groundwater.

A public notice is required prior to obtaining a permit to appropriate public waters. A 30 day comment period is provided after public notice. The Colorado State Engineer evaluates the application and any objections which were filed in response to the public notice with particular attention to the following questions:

- Is water available to satisfy the applicants needs?
- Would the appropriation of water impair the senior rights or injure the instream values of the water source?
- Does the applicant propose a beneficial use of water?
- Would the appropriation be detrimental to the public interest?

Permits may be issued which may authorize water use for a limited period of time (a temporary permit). In addition, changes to existing water rights must be reviewed and approved (i.e., point of withdrawal, changes in use, etc.).

Any permit issued must be specific as to the following:

- Water quantities to be appropriated, instantaneous and annual;
- The period of use;
- The point from which the water may be obtained;
- The purpose for which the water may be used; and,
- The place of use.

Provisions and limitations specific to the proposed water use and a development schedule for completing the project are normally associated with the permit. A permit only authorizes development of a project and does not represent the extent of a final water right. To the extent that water is beneficially used within the limitations of a "regular" permit, a certificate of a water right may be issued documenting a perfected water right. The processing time of a water right varies but can take up to 18 months. Public notice is required for water right applications.

15.0 COLORADO STATE HISTORIC PRESERVATION OFFICE

The Colorado State Historic Preservation Office must be contacted prior to the start of a project to determine if historic and archaeological sites will be affected. The status of any sites or structures listed in or eligible for National Register of Historic Places or local landmark designation will need to be determined. Plans for protection or mitigation measures may be a condition of concurrence with agency determined cultural impacts.

The Colorado State Historic Preservation Office also must be consulted when projects are subject to review under Section 106 of the National Historic Preservation Act of 1966. This act requires that all federal agencies take into account the effect of their actions on historic properties. The Colorado State Historic Preservation Office should be consulted to determine if

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the site has been surveyed, if there are identified historic resources on site, and if the property is listed or eligible for listing on the National Register of Historic Places. If the project will adversely affect property that meets the National Historic Register criteria, the Colorado State Historic Preservation Office will recommend ways to avoid or mitigate that adverse affect.

16.0 COLORADO DEPARTMENT OF TRANSPORTATION

The Colorado Department of Transportation is responsible for compliance with Colorado state requirements for road design and construction. This agency's responsibilities in the case of the North Fork Coal EIS will probably be limited to review and approval of applications for any upgraded road access permits. The Colorado Department of Transportation also monitors traffic loads on highways to ensure that proper maintenance is completed and that any future highway expansions to handle traffic are budgeted.

17.0 COLORADO DEPARTMENT OF LOCAL AFFAIRS

The Colorado Department of Local Affairs does not have any regulatory authority; however, this group is responsible for distribution of energy impact tax funds and revenues received as part of the reimbursement of federal royalties from coal mining to the states. Responsibilities of this agency are to review the needs of energy impacted counties within the state and distribute funds for various projects that alleviate the economic impacts of such development. The Colorado Department of Local Affairs considers applications for funding from counties and communities.

18.0 DELTA COUNTY

Delta County has no zoning requirements.

Delta County does require permits to construct permanent buildings. The applications for building permits require detailed plans for structures including electrical plans, plumbing plans, floor layout, sewage facilities, location of wells (if applicable), drainage plans, size and shape of the buildings, access, size and shape of the foundation walls, beams, air vents, window access, and heating and cooling mechanical aspects. Permits are issued upon approval of the plans. The county may inspect the buildings during construction.

19.0 GUNNISON COUNTY

Gunnison County has zoning requirements which are overseen by the Gunnison County Planning Department Special Use permits for activities in the county must be obtained prior to construction.

Gunnison County also has building permit requirements similar to Delta County.

Appendix C

Unsuitability Analysis Report Iron Point Coal Lease Tract

APPENDIX C
UNSUITABILITY ANALYSIS REPORT
IRON POINT COAL LEAST TRACT
(COC-61209)

NOTE: See *Figure C/D-1, Coal Unsuitability Criteria Locations*. This figure is included with the second volume of the EIS.

DESCRIPTION OF THE FEDERAL LANDS INVOLVED

This unsuitability analysis has been prepared for the Iron Point Tract, a 3,404.28 acre tract of federal coal lands described as:

T12S, R91W, 6th Principal Meridian,	
Section 33, Lots 1 to 16, inclusive, and S½N½;	776.00 acres
Section 34, Lots 1 to 16, inclusive, and S½N½;	782.20 acres
T13S, R91W, 6th Principal Meridian,	
Section 2, SW¼NW¼, NW¼SW¼, E½SW¼;	160.00 acres
Section 3, Lots 1 to 4, inclusive, S½N½ and N½S½;	483.04 acres
Section 4, Lots 1 to 4, inclusive, S½N½ and S½;	643.04 acres
Section 5, S½SE¼, SE¼SW¼;	120.00 acres
Section 8, NE¼;	160.00 acres
Section 9, NW¼, N½SW¼;	240.00 acres
Section 11, NE¼NW¼;	120.00 acres

This tract was identified as a result of a coal lease application submitted by Bowie Resources, Ltd. (Bowie) in August 1977. The tract lies approximately 4 miles east of the town of Somerset in Delta County, Colorado. Approximately 2,801 acres are federal surface and federal minerals. The USDA Forest Service (Forest Service) manages the surface of 1,558 acres and the Bureau of Land Management (BLM) manages 1,243 acres. The remainder of the surface (602 acres) is owned by Bowie and William G. Hughes, Pat A. Hughes and Brian C. Hughes; the mineral estate is federally owned. The tract lies adjacent to two existing producing coal mines.

As a first step in this analysis, the preliminary mining plan submitted by the applicant was examined in order to identify areas in which the proposed underground mining operation would produce surface effects. All of the areas on which surface facilities associated with the proposed operation were to be located and all the areas identified as likely to be affected by subsidence were delineated as having surface effects.

The unsuitability criteria were then applied individually to the areas identified as having surface effects. Each criterion was applied individually and maps were developed showing the applicability of the criterion. Then after all criteria had been applied, the exceptions of each criterion found to be applicable were then examined to determine if the exceptions were also applicable.

Finally, after the process had been completed, a summary, stating the conclusions of the report was written.

In compiling this analysis and report, the unsuitability criteria published in 43 CFR 3461 were used. The unsuitability criteria were applied individually to the area being considered. Exceptions to certain criteria allow areas to be considered further even though they have been determined to be unsuitable. These exceptions to the criteria are noted where applied.

ANALYSIS OF THE UNSUITABILITY CRITERIA

Exemptions to the criteria are not described as no exemptions were determined to apply. Exceptions to the criteria are described only if they apply.

Criterion 1

All federal lands included in the following land systems or categories shall be considered unsuitable: National Park System, National Wildlife Refuge System, National System of Trails, National Wilderness Preservation System, National Wild and Scenic Rivers System, National Recreation Areas, lands acquired with money derived from the Land and Water Conservation Fund, National Forests, and federal lands in incorporated cities, towns, and villages.

Exceptions. (i) A lease may be issued within the boundaries of any National Forest if the Secretary finds no significant recreational, timber, economic or other values which may be incompatible with the lease; and (A) surface operations and impacts are incident to an underground coal mine, or (B) where the Secretary of Agriculture determines, with respect to lands which do not have significant forest cover within those National Forests west of the Meridian, that surface mining may be in compliance with the Multiple-Use Sustained-Yield Act of 1960, the Federal Coal Leasing Amendments Act of 1976 and the Surface Mining Control and Reclamation Act of 1977.

Analysis

The lands within Sections 33 and 34 T13S, R91W, 6th PM were proclaimed National Forest on June 6, 1905 and are within the Gunnison National Forest. Conditions under which coal leasing may occur are listed in the Amended Land and Resource Management Plan (LRMP), Grand Mesa, Uncompahgre and Gunnison National Forests - General Direction on pages III-62 through III-70 and in the Grand Mesa, Uncompahgre and Gunnison National Forests Oil and Gas Leasing Environmental Impact Statement.

The stipulations set forth in these documents will protect specific resources which are found on the lease, and thereby satisfy the condition that the "Secretary finds no significant recreational, timber, economic or other values which may be incompatible with the lease." In addition, surface operations and impacts are incident to an underground coal mine.

Criterion 2

Federal lands that are within rights-of-way or easements or within surface leases for residential, commercial, industrial, or other public purposes, on federally-owned surface shall be considered unsuitable.

Exceptions. A lease may be issued and mining operations approved, in such areas if the surface management agency determines that (i) all or certain types of coal development (e.g., underground mining) will not interfere with the purpose of the right-of-way or easement, or (ii) the right-of-way or easement was granted for mining purposes, or (iii) the right-of-way or easement was issued for a purpose for which it is not being used, or (iv) the parties involved in the right-of-way or easement agree, in writing, to leasing, or (v) it is impractical to exclude such areas due to the location of coal and method of mining and such areas or uses can be protected through appropriate stipulations.

Analysis

There are two rights-of-way located on the application lands managed by the BLM, a power line (COC-22713) and Delta County Road 44.05 Drive (COC-42671, Hubbard Creek Road), totaling 24 acres. Lands involved in these rights-of-way are suitable for coal leasing after applying the exceptions to the criteria. The road R/W is protected by Criterion No. 3 (see below); the powerline will be protected by exception (v) above. The powerline right-of-way is 125 feet in width and includes access roads. In order to protect the powerline, the following lease stipulation will be required:

> State-of-the-art mining techniques (pillar and panel widths, rate of coal development and extraction, mine method, determining angle of draw, etc.) shall be used to control subsidence. No mining related surface disturbances will occur within 100 feet of the outside line of the powerline right-of-way without a written finding from the Authorized Officer and consultation with the right-of-way holder. These techniques would provide for maximum coal removal while insuring that sufficient coal is left in place to prevent subsidence.

There is a General Land Office Order, 6/1/1910, which classifies the lands within the application area for coal. The lands are also within the Paonia-Somerset Known Recoverable Resource Area, COC-20093. No other easements or surface leases for residential, commercial, industrial, or other public purposes are determined to exist within the review area.

Criterion 3

Federal lands affected by section 522(e)(4) and (5) of the Surface Mining Control and Reclamation Act of 1977 shall be considered unsuitable. This includes lands within 100 feet of the outside line of the right-of-way of a public road, or within 100 feet of a cemetery, or within 300 feet of any public building, school, church, community or institutional building or public park, or within 300 feet of an occupied dwelling.

Exceptions. A lease may be issued for lands (i) used as mine access roads or haulage roads that join the right-of-way for a public road, (ii) for which the Office of Surface Mining Reclamation and Enforcement has issued a permit to have public roads relocated, (iii) if, after public notice and opportunity for public hearing in the locality, a written finding is made by the Authorized Officer that the interests of the public and the landowners affected by mining within 100 feet of a public road will be protected, or (iv) for which owners of occupied dwellings have given written permission to mine within 300 feet of their buildings.

Analysis

Approximately 900 feet (1.2 acres) public road, Delta County Road 44.05 Drive, is located on the proposed lease tract. No occupied dwellings, public buildings, schools, churches, community, or institutional buildings exist within this area.

All of the lands affected by this criterion are suitable for coal leasing with application of the exceptions. A lease stipulation will be required to protect the public road from surface disturbance and subsidence. Hubbard Creek County Road will be protected from surface disturbance and subsidence due to mining by the following stipulation:

> No mining related disturbances will occur within 100 feet of the outside line of the right-of-way of Hubbard Creek County Road (44.05 Drive). The angle of draw used to protect the road from subsidence will be dictated by the approved CDMG Mining and Reclamation Plan, (the estimated angle of draw is conservatively estimated to be 25 degrees). However, mining related disturbances may occur if, after public notice and the opportunity for public hearing in the locality, a written finding is made by the Authorized Officer that the interests of the public and the landowners affected by mining within 100 feet of a public road will be protected.

Criterion 4

Federal lands designated as wilderness study areas shall be considered unsuitable while under review by the Administration and Congress for possible wilderness designation. For any federal land which is to be leased or mined prior to completion of the wilderness inventory by the surface management agency, the environmental assessment or impact statement on the lease sale or mine plan shall consider whether the land possesses the characteristics of a wilderness study area. If the finding is affirmative, the land shall be considered unsuitable, unless issuance of noncompetitive coal leases and mining on leases is authorized under the Wilderness Act and the Federal Land Policy and Management Act of 1976.

Analysis

No lands within the review area are designated Wilderness Study Areas.

Criterion 5

Scenic federal lands designated by visual resource management analysis as Class I (an area of outstanding scenic quality or high visual sensitivity) but not currently on the National Register of Natural Landmarks shall be considered unsuitable. A lease may be issued if the surface management agency determines that surface coal mining operations will not significantly diminish or adversely affect the scenic quality of the designated area.

Analysis

No lands within the review area are designated as visual resource management Class I areas.

Criterion 6

Federal lands under permit by the surface management agency, and being used for scientific studies involving food or fiber production, natural resources, or technology demonstrations and experiments shall be considered unsuitable for the duration of the study, demonstration, or experiment except where mining could be conducted in such a way as to enhance or not jeopardize the purposes of the study, as determined by the surface management agency, or where the principal scientific use or agency give written concurrence to all or certain methods of mining.

Analysis

No lands within the review area are under permit for scientific study.

Criterion 7

All publicly-owned places on federal lands which are included in the National Register of Historic Places shall be considered unsuitable. This shall include any areas that the surface management agency determines, after consultation with the Advisory Council on Historic Preservation and the State Historic Preservation Officer, are necessary to protect the inherent values of the property that made it eligible for listing in the National Register.

Analysis

No publicly-owned places on federal or fee lands within the review area are included in the National Register of Historic Places.

Criterion 8

Federal lands designated as natural areas or as National Natural Landmarks shall be considered unsuitable.

Analysis

No lands within the review area are designated as natural areas or as National Natural Landmarks.

Criterion 9

Federally designated critical habitat for listed threatened or endangered plant and animal species, and habitat proposed to be designated as critical for listed threatened or endangered plant and animal species or species proposed for listing, and habitat for federal threatened or endangered species which is determined by the Fish and Wildlife Service and the surface management agency to be of essential value and where the presence of threatened or endangered species has been scientifically documented, shall be considered unsuitable.

Exceptions. A lease may be issued and mining operations approved if, after consultation with the Fish and Wildlife Service, the Fish and Wildlife Service determines that the proposed activity is not likely to jeopardize the continued existence of the listed species and/or its critical habitat.

Analysis

No lands within the review area are designated as critical habitat, proposed to be designated as critical habitat, or determined to be essential habitat for any federally listed threatened or endangered plant or animal species, or species proposed for listing (Federal Register, various dates). However, critical habitat for the Colorado squawfish, Razorback sucker, Humpback chub, and Bonytail chub does exist off-site in the Colorado River drainage which potentially could be affected by water depletion from this action (Federal Register/Vol. 59, No. 54). The Fish and Wildlife Service has concluded that any water depletion in the upper Colorado River Basin "may effect" these endangered fish species and their critical habitat. At this time no specific projections of water depletions that may result from development of the review area are available. At the post-leasing stage, prior to the approval of the mine plan, if it is determined that development of the lease would result in water depletions in the upper Colorado River Basin, the permitting agency must enter into consultation with the Fish and Wildlife Service to determine the appropriate conservation measures to offset the effect to these listed fish.

Potential habitat for southwest willow flycatchers is known to be present in Hubbard Creek, just off the proposed lease tract. Within the study area, potentially suitable habitat for this species may exist in the riparian zones of Terror Creek and Hubbard Creek. No data currently indicates that the species is present in the review area or that there is any essential habitat on the review area. Prior to any disturbance within a riparian zone, the lessee must conduct inventories to determine if suitable habitat is present for this species, and if so, must conduct inventories for the species prior to authorization being granted for the disturbance. If the species is present, consultation with the Fish and Wildlife Service will determine the appropriate conservation measures, which may include avoidance of suitable habitat, a seasonal constraint within 150 feet of the occupied habitat, or the improvement of an off-site habitat area to benefit southwest willow flycatchers.

The following list of federally listed endangered, threatened, and candidate species are known to occur on the review area and/or in the region of potential effect of this action and were considered under this criterion (species list provided by the Fish and Wildlife Service, 1998):

Black-footed ferret	*Mustela nigripes*	END
Crane, whooping	*Grus americana*	END
Mexican spotted owl	*Strix occidentalis*	THR
Bald eagle	*Haliaeetus leucocephalus*	THR
Southwest willow flycatcher	*Empidonax traillii traillii*	END
Peregrine falcon	*Falco peregrinus anatum*	END
Bonytail chub	*Gila elegans*	END
Colorado squawfish	*Ptychocheilus lucius*	END
Humpback chub	*Bila cypha*	END
Razorback sucker	*Xyrauchen texanus*	END
Uinta basin hookless cactus	*Sclerocactus glaucus*	THR
Clay loving wild buchwheat	*Erigonum pelinophilum*	END

Criterion 10

Federal lands containing habitat determined to be critical or essential for plant or animal species listed by a state pursuant to state law as endangered or threatened shall be considered unsuitable.

Exceptions. A lease may be issued and mining operations approved if, after consultation with the state, the surface management agency determines that the species will not be adversely affected by all or certain stipulated methods of coal mining.

Analysis

No lands within the review area, or off-site that would be affected by this action, have been determined by the state of Colorado as critical or essential habitat for any state listed endangered or threatened animal species. No plant species are listed by the state of Colorado as threatened or endangered. In addition to the species appearing on the federal list above, the river otter (*Lutra conadensis*), boreal toad (*Bufo boreas boreas*), and Canada lynx (*Lynx canadensis*), listed endangered by the state of Colorado, were considered as potentially occurring on the review area or in the region of potential effect and were considered under this criterion. Typical lynx habitat is over 9,000 feet in elevation, which is higher than the review area. Current data indicates that the lynx may be confined to isolated locations in the central part of the state. It is unlikely that the species would occur on the review area. River otters are known to occur in the Gunnison Gorge, and they have been reported in the North Fork of the Gunnison River. No data indicates that the species has been found in the streams on the review area. Grand Mesa is historic habitat for the boreal toad, which requires marsh, pond, bog, or wet meadow habitat in spruce-fir forests or alpine meadows, at elevations above 8,000 feet, for breeding (Boreal Toad Recovery Plan, 1994). There is no data to indicate that the review area has these habitat types at the required elevation.

Criterion 11

A bald or golden eagle nest site on federal lands that is determined to be active, and an appropriate buffer zone of land around the nest site shall be considered unsuitable. Consideration of availability of habitat for prey species and of terrain shall be included in the determination of buffer zones. Buffer zones shall be determined in consultation with the Fish and Wildlife Service.

Exceptions. A lease may be issued if (1) it can be conditioned in such a way, either in manner or period of operation, that eagles will not be disturbed during the breeding season, or (2) the surface management agency, with the concurrence of the Fish and Wildlife Service, determines that the golden eagle nest(s) will be moved, or (3) buffer zones may be decreased if the surface management agency determines that the active eagle nests will not be adversely affected.

Analysis

Presently, no bald or golden eagle nest sites exist on federal lands within the review area. Three known golden eagle nests are located off the northeast corner of the review area; one nest location is within one-half mile of the eastern boundary of the review area in Section 35. A buffer zone of one-quarter mile radius around bald and golden eagle nest sites was suggested as adequate protection in the Uinta-Southwestern Utah Coal Region EIS. Present guidelines used by the Fish and Wildlife Service are:

Bald Eagle

1. Year round closure to surface occupancy (beyond that which historically occurred in the area) within one-quarter mile radius of nests,

2. No activity from November 15 through July 30 within one-half mile radius of active bald eagle nests. Total potential area of protection is one-half mile radius of the nest.

Golden Eagle

1. No surface occupancy (beyond that which historically occurred in the area) within one-quarter mile radius of the nest site and associated alternate nests,

2. Seasonal restrictions to human encroachment within one-half mile of the nest and any alternate nests from February 1 through July 15

Underground coal mining and nesting bald or golden eagles are compatible on the same tract of land unless surface facilities or surface disturbances cause nest-site abandonment. With respect to bald or golden eagle nests which may be established on the review area during the life of the project, the following special stipulations shall apply:

1. No new permanent surface facilities or disturbances except subsidence shall be located within a one-quarter mile radius buffer zone around each bald or golden eagle nest site.

2. No surface activities will be allowed within a one-half mile radius buffer zone around each active eagle nest site from November 15 to July 30 for bald eagles and February 1 to July 15 for golden eagles.

3. Any proposed surface facilities, disturbances or activities (as noted above) in or adjacent to these buffer zones will require approval from the surface management agency on a site-specific basis, alter consultation with the Fish and Wildlife Service.

Criterion 12

Bald and golden eagle roost and concentration areas on federal lands used during migration and wintering shall be considered unsuitable.

Analysis

No bald or golden eagle roost or concentration areas are known to exist on federal lands within the review area. Bald eagle use in this area, both along the North Fork of the Gunnison River above Paonia and the uplands has been determined as light by the BLM and Forest Service. Bald eagles use the review area sporadically for foraging.

With respect to bald or golden eagle roost sites or concentration areas which may be established on the review area during the life of the project, the following special stipulation shall be applied:

1. No surface activity except subsidence shall occur within one-quarter mile radius of winter roosts between November 15 and March 15, development may be permitted at other periods. If periodic visits are required within the buffer zone after development, activity should be restricted to the hours of 10:00 a.m. and 2:00 p.m. from November 15 through March 15.

Criterion 13

Federal lands containing a falcon (excluding kestrel) cliff nesting site with an active nest and buffer zone of federal land around the nest site shall be considered unsuitable. Consideration of availability of habitat for prey species and of terrain shall be included in the determination of buffer zones. Buffer zones shall be determined in consultation with the Fish and Wildlife Service.

Exception. A lease may be issued where the surface management agency, after consultation with the Fish and Wildlife Service, determines that all or certain stipulated methods of coal mining will not adversely affect the falcon habitat during the periods when such habitat is used by the falcons.

Analysis

No falcon cliff nesting sites are known to exist on federal lands within the review area. Available cliff sites for nesting within the review area are short, and atypical of the cliff sites being selected by peregrine and prairie falcons for nesting elsewhere in the local areas.

Criterion 14

Federal lands which are high priority habitat for migratory bird species of high federal interest on a regional or national basis, as determined jointly by the surface management agency and the Fish and Wildlife Service, shall be considered unsuitable.

Exception. A lease may be issued where the surface management agency, after consultation with the Fish and Wildlife Service, determines that all or certain stipulated methods of coal mining will not adversely affect the migratory bird habitant during the periods when such habitat is used by the species.

Analysis

The following list of migratory bird species of high federal and/or state interest are known, or considered likely, to breed and nest within the review area or vicinity:

Band-tailed pigeon
Black swift
Cooper's hawk
Flammulated owl
Golden eagle
Great blue heron
Loggerhead shrike
Lewis' woodpecker
Peregrine falcon
Prairie falcon
Three-toed Woodpecker
Williamson's sapsucker
Northern Goshawk

Also, a total of eighty-six species of neotropical migrant birds are known to breed or migrate regularly through some part of Colorado. Recent studies in Colorado conclude that 41% of these neotropical migrant species are declining in numbers. The study also showed that riparian communities, followed by gambel oak communities support the highest number of breeding bird.

Underground coal mining would impact these species to the degree that the human and surface-disturbing activities would impact their breeding and nesting activities and habitats in riparian and gambel oak communities. Of particular high importance are the riparian areas throughout the review area, specifically in Terror Creek and Hubbard Creek. Riparian areas are suitable for coal leasing only with inclusion of the following special stipulation to protect the above mentioned migratory bird species:

1. A one-eighth mile buffer zone (660 feet) will be protected on either side of riparian zones (or a buffer zone may be established in accordance with the surface management agency guidelines).

2. No surface disturbances, except surface subsidence, will be permitted within these buffer zones, unless no practical alternatives exist.

3. Other raptors (except American kestrel):

    a. Conduct surveys for nesting raptors on the lease tract prior to development of any surface facilities.

    b. No surface activities will be allowed within one-half mile radius of active nest sites between the dates of February 1 and August 15, unless authorized by the BLM or Forest Service on a site specific basis.

4. All unavoidable surface disturbance will require approval of the Forest Service or BLM Authorized Officer. The BLM or Forest Service will coordinate with the Fish and Wildlife Service and the Colorado Division of Wildlife to determine the type and extent of allowable variances. A site specific analyses will determine if this stipulation will apply.

Criterion 15

Federal lands which the surface management agency and the state jointly agree are habitat for resident species of fish, wildlife and plants of high interest to the state and which are essential for maintaining these priority wildlife and plant species shall be considered unsuitable. Examples of such lands which serve a critical function for the species involved include: (i) active dancing and strutting grounds for sage grouse, sharp-tailed grouse, and prairie chicken, (ii) winter ranges crucial for deer, antelope, and elk, (iii) migration corridor for elk, and (iv) extremes of range for plant species.

Exceptions. A lease may be issued if, after consultation with the state, the surface management agency determines that all or certain stipulated methods of coal mining will not have a significant long-term impact on the species being protected.

Analysis

According to the Colorado Division of Wildlife's current mapping of seasonal ranges for mule deer and elk, none of the lands in the review area are considered to be crucial winter range (winter concentration area or severe winter range). Current Colorado Division of Wildlife mapping of winter ranges indicates that the entire review area is winter range for elk, and portions of Sections 8, 9, and 11 on the south end of the review area are considered winter range for mule deer. Surface disturbing activities in this area caused by underground coal mining would impact elk and mule deer winter ranges. The review area is suitable for coal leasing only with inclusion of the following special protective stipulations on those areas that may be designated as crucial winter range during the life of the project:

1. Coal related facilities and surface disturbances except subsidence will be authorized in the review area only if no practical alternatives exist.
2. The BLM and Forest Service will coordinate with the Colorado Division of Wildlife to determine the type and extent of allowable variances.
3. Coal exploration, facility construction, and major scheduled maintenance will not be authorized within crucial winter ranges from December 1 through April 30.
4. All unavoidable surface disturbances within the crucial winter ranges during these times will require approval of the BLM and Forest Service Authorized Officer.

No other federal lands within the review area, or off-site that would be affected by the proposed action are considered critical or essential habitat for resident species of fish, wildlife or plants of high interest to the state of Colorado.

Criterion 16

Federal lands in riverine, coastal, and special floodplains (100-year recurrent interval) on which the surface management agency determines that mining could not be undertaken without substantial threat of loss of life or property shall be considered unsuitable for all or certain stipulated methods of coal mining.

Analysis

The application lands are not within a riverine, coastal or special floodplain.

Criterion 17

Federal lands which have been committed by the surface management agency to use as municipal watersheds shall be considered unsuitable.

Analysis

None of the lands in the proposed lease tract are within a municipal watershed.

Criterion 18

Federal lands with National Resource Waters, as identified by states in their water quality management plans, and a buffer zone of federal lands one-quarter mile from the outer edge of the far banks of the water, shall be unsuitable.

Analysis

None of the lands in the proposed lease tract are identified as National Resource Water.

Criterion 19

Federal lands identified by the surface management agency, in consultation with the state in which they are located, as alluvial valley floors according to the definition in Subpart 3400.0-5(a) of this title, the standards of 30 CFR Part 822, the final alluvial floor guidelines of the Office of Surface Mining Reclamation and Enforcement when published, and approved state programs under the Surface Mining Control and Reclamation Act of 1977, where mining would interrupt, discontinue, or preclude farming, shall be considered unsuitable. Additionally, when mining federal land outside an alluvial valley floor would materially damage the quantity or quality of water in surface or underground water systems that would supply alluvial valley floors, the land shall be considered unsuitable.

Analysis

The application lands are not within an alluvial valley floor, but such lands drain into the North Fork of the Gunnison River, along which both surface irrigated and potentially irrigable sites exist. However, material damage to the quality and quantity of water arising on or flowing over the proposed lease tract is not anticipated.

Criterion 20

Federal lands in a state to which is applicable a criterion (i) proposed by the state or Indian tribe located in the planning area, and (ii) adopted by rulemaking by the Secretary, shall be considered unsuitable.

Analysis

This criterion is not presently in effect in the state of Colorado.

SUMMARY

The Iron Point Tract was determined to be suitable for coal mining following the application of Unsuitability Criteria numbers 4, 5, 6, 7, 8, 10, 13, 16, 17, 18, 19 and 20.

Criterion Numbers 1, 2, 3, 9, 11, 12, 14 and 15 were found to be unsuitable for mining, however, after applying the exceptions to the criterion, they were suitable for mining with the following restrictions:

Criterion 1: The lands within Sections 33 and 34, T13S, R91W, 6th PM were proclaimed National Forest on June 6, 1905 and are within the Gunnison National Forest. These lands are considered suitable for coal mining after applying the exception to Criteria number 1.

Criterion 2: State-of-the-art mining techniques (pillar and panel widths, rate of coal development and extraction, mine method, determining angle of draw, etc.) shall be used to control subsidence. No mining related surface disturbances will occur within 100 feet of the outside line of the powerline right-of-way without a written finding from the Authorized Officer and consultation with the right-of-way holder. These techniques would provide for maximum coal removal while insuring that sufficient coal is left in place to prevent subsidence.

Criterion 3: No mining related disturbances will occur within 100 feet of the outside line of the right-of-way of Hubbard Creek County Road (44.05 Drive). The angle of draw used to protect from subsidence will be dictated by the approved Division of Mining and Geology Mining and Reclamation Plan, (the estimated angle of draw is conservatively estimated to be 25 degrees). However, mining related disturbances may occur if, after public notice and the opportunity for public hearing in the locality, a written finding is made by the Authorized Officer that the interests of the public and the landowners affected by mining within 100 feet of a public road will be protected.

Criterion 9: For water depletions, as part of the Mine Permit Application Package, the lessee shall furnish to the Regulatory Officer of the Office of Surface Mining an estimate of the average annual water depletion resulting from the proposed action. Consultation with the Fish and Wildlife Service may be required for any planned depletions. Conservation measures for the depletion will be determined during consultation. Conservation measures may include a one time payment, per acre-foot, to the Recovery Program at a fee to be established by the Fish and Wildlife Service. Arrangements for receiving the remitted funds from the lessee will be coordinated directly with the lessee by the Office of Surface Mining.

No surface disturbance or facilities will be located in occupied southwest willow flycatcher habitat. Prior to any planned disturbance within riparian habitats on the lease, the lessee must: 1) Survey the area of the proposed disturbance for suitable southwest willow flycatcher habitat, and survey all suitable habitat for the presence of the species. All habitat and species surveys must be in accordance with the accepted Fish and Wildlife Service protocol; 2) Provide the results of all surveys to the Fish and Wildlife Service, the Montrose District of the BLM and the Paonia Ranger District of the Forest Service; 3) If suitable habitat or individuals are located in the area, consultation with the Fish and Wildlife Service will be required to determine suitable conservation measures to prevent a "take" under section 9 of the Endangered Species Act. Conservation measures may include avoidance of the occupied habitat, establishment of a buffer zone and seasonal restriction around occupied habitat, or others developed for the specific site. In accordance with current protocol, surveys for the presence of the species are valid for only one year.

Criteria 11: With respect to bald or golden eagle nests which may be established on the review area during the life of the project, the following special stipulations shall be applied:

1. No new permanent surface facilities or disturbances except subsidence shall be located within a one-quarter mile radius buffer zone around each bald or golden eagle nest site.

2. No surface ground activities will be allowed within a one-half mile radius buffer zone around each bald eagle active nest site from November 15 to July 30, and around each active golden eagle nest site from February 1 to July 15.

3. Any proposed surface facilities, disturbances or activities (as noted above) in, or adjacent to these buffer zones will require approval from the BLM or Forest Service, on a site-specific basis, after consultation with the Fish and Wildlife Service.

Criterion 12: With respect to bald or golden eagle roost sites or concentration areas which may be established on the review area during the life of the project the following special stipulation shall be applied:

1. No surface ground activity except subsidence shall occur within one-quarter mile radius of winter roosts between November 15 and March 15, development may be permitted at other periods. If periodic visits are required within the buffer zone after development, activity should be restricted to the hours of 10:00 a.m. and 2:00 p.m. from November 15 through March 15.

Criterion 14: Riparian zones are present within the review area and are suitable for coal leasing only with inclusion of the following special stipulations to protect resident and migratory bird species:

1. A one-eighth mile buffer zone (660 feet) will be protected on either side of riparian zones (or a buffer zone may be established in accordance with the surface management agency guidelines). No surface disturbances, except surface subsidence, will be permitted within these buffer zones, unless no practical alternatives exist. All unavoidable surface disturbance will require approval of the Forest Service or BLM's Authorized Officer. The BLM or Forest Service will coordinate with the Fish and Wildlife Service and the Colorado Division of Wildlife to determine the type and extent of allowable variances. A site specific analyses will determine if this stipulation will apply.

2. With respect to other raptors (except American kestrel) which may occur or become established on the Iron Point Tract during the life of the project, the following special stipulation shall apply:

   > Conduct surveys for nesting raptors on the lease tract prior to development of any surface facilities. No surface activities will be allowed within one-half mile radius of active nest sites between the dates of February 1 and August 15, unless authorized by BLM or Forest Service on a site-specific basis.

Criterion 15: If areas are determined by the Colorado Division of Wildlife to be mule deer and elk crucial winter range, the following stipulation shall be applied:

1. Coal related facilities and surface disturbances except subsidence will be authorized in the review area only if no practical alternatives exist. The BLM and Forest Service will coordinate with the Colorado Division of Wildlife to determine the type and extent of allowable variances. Coal exploration, facility construction, and major scheduled maintenance will not be authorized within these crucial winter ranges from December 1 through April 30. All unavoidable surface disturbances within these crucial winter ranges during these times will require approval of the Authorized Officer.

REFERENCES

Bureau of Land Management, Various dates, unpublished Wildlife Inventories and Observations, Uncompahgre Basin Resource Area. Montrose, Colorado.

Colorado State Statutes, 1988. Division of Wildlife and Division of Parks and Outdoor Recreation, Title 33, Chapter 10, Article 11 and 111.

Federal Register. 1990. Vol. No., U.S. Department of the Interior, Fish and Wildlife Service, Washington DC.

Federal Register. 1991. Vol.. No., U.S. Department of the Interior, Fish and Wildlife Service, Washington DC.

Federal Register. 1991, Vol. No., U.S. Department of the Interior, Fish and Wildlife Service, Washington DC.

U.S. Department of the Interior, 1983. Uinta-Southwestern Utah Coal Region Environmental Impact Statement, U.S. Department of the Interior, Bureau of Land Management, Utah State Office, Salt Lake City, Utah.

U.S. Fish and Wildlife Service, 1992. Informal Section 7 Consultation, Western Colorado Suboffice, Grand Junction, CO.

CONSULTATION AND COORDINATION

The following agencies and organizations were contacted to gain information pertinent to the application of the 20 coal suitability criteria:

Federal Agencies

U.S. Department of the Interior
Fish and Wildlife Service
Western Colorado Suboffice
529 251/2 Road
Grand Junction, CO 81505-6199

Office of Surface Mining

Department of Energy, WAPA

Colorado State Agencies

Division of Wildlife, Southwest Region Office, Montrose, CO
Colorado Division of Minerals and Geology

County Agencies

Delta County Planning Department

Appendix D

Unsuitability Analysis Report Elk Creek Coal Lease Tract

APPENDIX D
UNSUITABILITY ANALYSIS REPORT
ELK CREEK TRACT
(COC-61385)

NOTE: See *Figure C/D-1, Coal Unsuitability Criteria Locations*. This figure is included within the second volume of the EIS.

DESCRIPTION OF THE FEDERAL LANDS INVOLVED

This unsuitability analysis has been prepared for the Elk Creek Tract, a 2.81± acre tract of federal coal lands described as:

T12S, R90W, 6th Principal Meridian	
Section 31, All;	733 acres
Section 32, Lots 3 to 6 and 11 to 14, inclusive; NW¼	493 acres
T12S, R92W, 6th Principal Meridian	
Section 35, E½	478 acres
Section 36, All	954 acres
T13S, R90W, 6th Principal Meridian	
Section 5, Lots 7 to 10, inclusive;	124 acres
Section 6, Lots 8 to 17, inclusive;	317 acres
T13S, R91W, 6th Principal Meridian	
Section 1, Lots 1 to 4, inclusive, S½NW¼, SW¼;	403 acres
Section 2, Lots 1, S½NE¼;	121 acres
Section 12, S½NE¼, NW¼;	240 acres

This tract was identified as a result of a coal lease application submitted by Oxbow Mining, Inc. (Oxbow) in November 1997. The tract lies northwest of the town of Somerset in Delta and Gunnison counties, Colorado. Approximately 1,702 acres are federal surface and federal minerals. The USDA Forest Service (Forest Service) manages the surface of 806 acres and the USDI Bureau of Land Management (BLM) manages 896 acres. The remainder of the surface (2,161 acres) is owned by Hotchkiss Ranches, Inc.; the mineral estate is federally owned. The tract lies between the two existing producing coal mines. The applicant's lease application was amended to include an additional 160 acres lying on the northeastern boundary of the application area in T12S, R90W, Section 31, 6th PM. The additional area was incorporated into the tract to ensure all federal coal for which there was adequate coal data was included to avoid a potential bypass of coal in the future. The Elk Creek Tract lies to the east of federal coal lease COC-53510 which is leased by Oxbow and is operated as the Sanborn Creek Mine.

As a first step in this analysis, the preliminary mining plan submitted by the applicant was examined in order to identify areas in which the proposed underground mining operation would produce surface effects. All of the areas on which surface facilities associated with the proposed operation were to be located and all of the areas identified as likely to be affected by subsidence were delineated as having surface effects.

The unsuitability criteria were then applied individually to the areas identified as having surface effects. Each criterion was applied individually and maps were developed showing the applicability of the criterion. Then after all criteria had been applied, the exceptions of each criterion found to be applicable were examined to determine if the exceptions were also applicable.

Finally, after the process had been completed, a summary stating the conclusions of the report was written.

In compiling this analysis and report, the unsuitability criteria published in 43 CFR 3461 were used. The unsuitability criteria were applied individually to the area being considered. Exceptions to certain criteria allow areas to be considered further even though they have been determined to be unsuitable. These exceptions to the criteria are noted where applied.

ANALYSIS OF THE UNSUITABILITY CRITERIA

Exemptions to the criteria are not described as no exemptions where determined to apply. Exceptions to the criteria are described only if they apply.

Criterion 1

All federal lands included in the following land systems or categories shall be considered unsuitable: National park System, National Wildlife Refuge System, National System of Trails, National Wilderness Preservation System, National Wild and Scenic Rivers System, National Recreation Areas, lands acquired with money derived from the Land and Water Conservation Fund, National Forests, and federal lands in incorporated cities, towns, and villages.

Exceptions. (I) A lease may be issued within the boundaries of any National Forest if the Secretary finds no significant recreational, timber, economic or other values which may be incompatible with the lease; and (A) surface operations and impacts are incident to an underground coal mine, or (B) where the Secretary of Agriculture determines, with respect to lands which do not have significant forest cover within those National Forests west of the Meridian, that surface mining may be in compliance with the Multiple-Use Sustained-Yield Act of 1960, the Federal Coal Leasing Amendments Act of 1976 and the Surface Mining Control and Reclamation Act of 1977.

Analysis

Some of the lands within Section 35, T12S, R91W, and Section 32, T12S, R90W, 6th PM were proclaimed National Forest on June 6, 1905 and are within the Gunnison National Forest. Conditions under which coal leasing may occur are listed in the Amended Land and Resource Management Plan (LRMP), Grand Mesa, Uncompahgre and Gunnison National Forests - General Direction on pages III-62 through III-70 and in the Grand Mesa, Uncompahgre and Gunnison National Forests Oil and Gas Leasing Environmental Impact Statement to which the LRMP tiers.

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Criterion 2

Federal lands that are within rights-of-way or easements or within surface leases for residential, commercial, industrial, or other public purposes, on federally-owned surface shall be considered unsuitable.

Exceptions. A lease may be issued, and mining operations approved, in such areas if the surface management agency determines that (i) all or certain types of coal development (e.g., underground mining) will not interfere with the purpose of the right-of-way or easement, or (ii) the right-of-way or easement was granted for mining purposes, or (iii) the right-of-way or easement was issued for a purpose for which it is not being used, or (iv) the parties involved in the right-of-way or easement agree, in writing, to leasing, or (v) it is impractical to exclude such areas due to the location of coal and method of mining and such areas or uses can be protected through appropriate stipulations.

Analysis

There is a right-of-way for a powerline and road (COC-41183) located on the application lands managed by the BLM. The right-of-way is authorized to Oxbow and used for mining purposes. Lands involved in this right-of-way are suitable for coal leasing after applying the exceptions to the criteria. The road R/W is an exception to Criterion No. 2 by Exception (ii) above. There is a General Land Office Order, 6/1/1910, which classifies the lands within the application area for coal. The lands are also within the Paonia-Somerset Known Recoverable Area, COC-20093. No other easements or surface leases for residential, commercial, industrial, or other public purposes are determined to exist within the Elk Creek Tract.

Criterion 3

Federal lands affected by Section 522(e)(4) and (5) of the Surface Mining Control and Reclamation Act of 1977 shall be considered unsuitable. This includes lands within 100 feet of the outside line of the right-of-way of a public road, or within 100 feet of a cemetery, or within 300 feet of any public building, school, church, community or institutional building or public park, or within 300 feet of an occupied dwelling.

Analysis

No public roads, occupied dwellings, public buildings, schools, churches, community, or institutional buildings exist within the Elk Creek Tract.

Criterion 4

Federal lands designated as wilderness study areas shall be considered unsuitable while under review by the Administration and Congress for possible wilderness designation. For any federal land which is to be leased or mined prior to completion of the wilderness inventory by the surface management agency, the environmental assessment or impact statement on the lease sale or mine plan shall consider whether the land possesses the characteristics of a wilderness study area. If the finding is affirmative, the land shall be considered unsuitable, unless issuance of noncompetitive coal lease and mining on leases is authorized under the Wilderness Act and the Federal Land Policy and Management Act of 1976.

Analysis

No lands within the Elk Creek Tract are designated Wilderness Study Areas.

Criterion 5

Scenic federal lands designated by visual resource management analysis as Class I (an area of outstanding scenic quality or high visual sensitivity) but not currently on the National Register of Natural Landmarks shall be considered unsuitable. A lease may be issued if the surface management agency determines that surface coal mining operations will not significantly diminish or adversely affect the scenic quality of the designated area.

Analysis

No lands within the Elk Creek Tract are designated as visual resource management Class I areas.

Criterion 6

Federal lands under permit by the surface management agency, and being used for scientific studies involving food or fiber production, natural resources, or technology demonstrations and experiments shall be considered unsuitable for the duration of the study, demonstration, or experiment except where mining could be conducted in such a way as to enhance or not jeopardize the purpose of the study, as determined by the surface management agency, or where the principal scientific use or agency give written concurrence to all or certain methods of mining.

Analysis

No lands within the Elk Creek Tract are under permit for scientific study.

Criterion 7

All publicly-owned places on federal lands which are included in the National Register of Historic Places shall be considered unsuitable. This shall include any areas that the surface management agency determines, after consultation with the Advisory Council on Historic Preservation and the State Historic Preservation Officer, are necessary to protect the inherent values of the property that make it eligible for listing in the National Register.

Analysis

No publicly-owned places on federal or fee lands within the Elk Creek Tract are included in the National Register of Historic Places.

Criterion 8

Federal lands designated as natural areas or as National Natural Landmarks shall be considered unsuitable.

Analysis

No lands within the Elk Creek Tract are designated as natural areas or as National Natural Landmarks.

Criterion 9

Federally designated critical habitat for listed threatened or endangered plant and animal species, and habitat proposed to be designated as critical for listed threatened or endangered plant and animal species or species proposed for listing, and habitat for federal threatened or endangered species which is determined by the Fish and Wildlife Service and the surface management agency to be of essential value and where the presence of threatened or endangered species has been scientifically documented, shall be considered unsuitable.

Exceptions. A lease may be issued and mining operations approved if, after consultation with the Fish and Wildlife Service, the Fish and Wildlife Service determines that the proposed activity is not likely to jeopardize the continued existence of the listed species and/or its critical habitat.

Analysis

No lands within the Elk Creek Tract are designated as critical habitat, proposed to be designated as critical habitat, or determined to be essential habitat for any federally listed threatened or endangered plant or animal species, or species proposed for listing (Federal Register, various dates). However, critical habitat for the Colorado squawfish, Razorback sucker, Humpback chub, and Bonytail chub does exist off-site in the lower Gunnison River which potentially could be affected by water depletion from this action (Federal Register/Vol. 59, No. 54). The Service has concluded that any water depletion in the upper Colorado River Basin "may effect" these endangered fish species and their critical habitat. At this time, no specific projections of water depletions that may result from development of the review area are available. At the post-leasing stage, prior to the approval of the mine plan, if it is determined that development of the lease would result in water depletions in the upper Colorado River Basin, the permitting agency must enter into consultation with the Fish and Wildlife Service to determine the appropriate conservation measures to offset the effect of these listed fish.

Potential habitat for southwestern willow flycatchers is known to be present in Hubbard Creek, just off the proposed lease tract. Within the study area, potentially suitable habitat for this species may exist in the riparian zones of Bear and Elk Creeks. No data currently indicates that the species is present in the review area or that there is any essential habitat on the review area. Prior to any disturbance within a riparian zone, the lessee must conduct inventories to determine if suitable habitat is present for this species, and, if so, must conduct inventories for the species prior to authorization being granted for disturbance. If the species is present, consultation with the Fish and Wildlife Service will determine the appropriate conservation measures, which may include avoidance of suitable habitat, a seasonal constraint within 150 feet of the occupied habitat, or the improvement of an off-site habitat area to benefit southwest willow flycatchers.

Peregrine falcons are known to nest on the Uncompahgre Plateau and in the Gunnison Gorge. These birds may use the lease tract for incidental foraging, but no nesting habitat for this species is found on or near the tract.

Bald eagles winter in the area, and may use the tract for incidental foraging. No essential habitat for this species exists on the lease tract.

The following list of federally listed endangered, threatened, and candidate species are known to occur on the Elk Creek Tract and/or in the region of potential effect of this action and were considered under this criterion (species list provided by the Fish and Wildlife Service, 1998). Only the species listed above were found to be potentially effected by the proposed lease.

Black-footed ferret	*Mustela nigripes*	END
Crane, whooping	*Grus americana*	END
Mexican spotted owl	*Strix occidentalis*	THR
Bald eagle	*Haliaeetus leucocephalus*	THR
Southwest willow-flycatcher	*Empidonax traillii traillii*	END
Peregrine falcon	*Falco peregrinus anatum*	END
Bony tail chub	*Gila elegans*	END
Colorado squawfish	*Ptychocheilus lucius*	END
Humpback chub	*Bila cypha*	END
Razorback sucker	*Xyrauchen texanus*	END
Uinta basin hookles cactus	*Sclerocactus glaucus*	THR
Clay loving wild buckwheat	*Erigonum pelinophilum*	END
Canada lynx	*Lynx canadensis*	PROPOSED

Criterion 10

Federal lands containing habitat determined to be critical or essential for plant or animal species listed by a state pursuant to state law as endangered or threatened shall be considered unsuitable.

Exceptions. A lease may be issued and mining operations approved if, after consultation with the state, the surface management agency determines that the species will not be adversely affected by all or certain stipulated methods of coal mining.

Analysis

No lands within the Elk Creek Tract, or off-site that would be effected by this action, have been determined by the state of Colorado as critical or essential habitat for any state listed endangered or threatened animal species. No plant species are listed by the state of Colorado as threatened or endangered. In addition to the species appearing on the Federal list above, the river otter (*lutra canadensis*), boreal toad (*Bufo boreas boreas*), and Canada Lynx (*Lynx canadensis*), listed endangered by the state of Colorado, were considered as potentially occurring on the review area or in the region of potential effect and were considered under this criterion. Typical lynx habitat is over 9,000 feet in elevation, which is higher than the review area. Current data indicates that the lynx may be confined to isolated locations in the central part of the state. It is unlikely that the species would occur on the review area. River otters are known to occur in the Gunnison Gorge, and they have been reported in the North Fork of the Gunnison. No data indicates that the species has been found in the streams on the review area. Grand Mesa is historic habitat for the boreal toad, which requires marsh, pond, bog, or wet meadow habitat in spruce-fir forests or alpine meadows, at elevations above 8,000 feet, for breeding (Boreal Toad Recovery Plan, 1994). There is no data to indicate that the Elk Creek Tract has these habitat types at the required elevation.

Criterion 11

A bald or golden eagle nest site on federal lands that is determined to be active, and an appropriate buffer zone of land around the nest site shall be considered unsuitable. Consideration of availability of habitat for prey species and of terrain shall be included in the determination of buffer zones. Buffer zones shall be determined in consultation with the Fish and Wildlife Service.

Exceptions. A lease may be issued if (1) it can be conditioned in such a way, either in manner or period of operation, that eagles will not be disturbed during the breeding season, or (2) the surface management agency, with the concurrence of the Fish and Wildlife Service, determines that the golden eagle nest(s) will be moved, or (3) buffer zones may be decreased if the surface management agency determines that the active eagle nests will not be adversely affected.

Analysis

Presently, no bald or golden eagle nest sites exist on federal lands within the Elk Creek Tract. Three known golden eagle nests are located off the northwest corner of the tract. Two nest locations are within one-half mile of the eastern boundary of the review area (see Map UC-1). A buffer zone of one-quarter mile radius around bald and golden eagle nest sites was suggested as adequate protection in the Uinta-Southwestern Utah Coal Region EIS. Present guidelines used by the Fish and Wildlife Service are:

Bald Eagle:

1. Year round closure to surface occupancy (beyond that which historically occurred in the area) within one-quarter mile radius of nests,

2. No activity from November 15 through July 30 within one-half mile radius of active bald eagle nests. Total potential area of protection is one-half mile radius of the nest.

Golden Eagle:

1. No surface occupancy (beyond that which historically occurred in the area) within one-quarter mile radius of the nest site and associated alternative nests,

2. Seasonal restrictions to human encroachment within one-half mile of the nest and any alternative nests from February 1 through July 15.

Underground coal mining and nesting bald or golden eagles are compatible on the same tract of land unless surface facilities or surface disturbances cause nest-site abandonment. With respect to bald or golden eagle nests which may be established on the tract during the life of the project, the following special stipulations shall be applied.

1. No new permanent surface facilities or disturbances except subsidence shall be located within a one-quarter mile radius buffer zone around each bald or golden eagle nest site.

2. No surface activities will be allowed within a one-half mile radius buffer zone around each active eagle nest site from November 15 to July 30 for bald eagles and February 1 to July 15 for golden eagles.

3. Any proposed surface facilities, disturbances or activities (as noted above) in or adjacent to these buffer zones will require approval from the surface management agency (on a site-specific basis, after consultation with the Fish and Wildlife Service.

Criterion 12

Bald and golden eagle roost and concentration areas on federal lands used during migration and wintering shall be considered unsuitable.

Analysis

No bald or golden eagle roost or concentration areas are known to exist on federal lands within the Elk Creek Tract. Bald eagle use in this area, both along the North Fork of the Gunnison River above Paonia and the uplands has been determined as light by the BLM and Forest Service. Bald eagles use the Elk Creek Tract sporadically for foraging.

With respect to bald or golden eagle roost sites or concentration areas which may be established on the Elk Creek Tract during the life of the project the following special stipulation shall be applied:

1. No surface activity except subsidence shall occur within one-quarter mile radius of winter roosts between November 15 and March 15, development may be permitted at other periods. If periodic visits are required within the buffer zone after development, activity should be restricted to the hours of 10:00 a.m. and 2:00 p.m. from November 15 through March 15.

Criterion 13

Federal lands containing a falcon (excluding kestrel) cliff nesting site with an active nest and buffer zone of federal land around the nest site shall be considered unsuitable. Consideration of availability of habitat for prey species and of terrain shall be included in the determination of buffer zones. Buffer zones shall be determined in consultation with the Fish and Wildlife Service.

Exception. A lease may be issued where the surface management agency, after consultation with the Fish and Wildlife Service, determines that all or certain stipulated methods of coal mining will not adversely affect the falcon habitat during the periods when such habitat is used by the falcons.

Analysis

No falcon cliff nesting sites are known to exist on federal lands within the Elk Creek Tract. Available cliff sites for nesting within the tract are short, and atypical of the cliff sites being selected by peregrine and prairie falcons for nesting elsewhere in western Colorado.

Criterion 14

Federal lands which are high priority habitat for migratory bird species of high federal interest on a regional or national basis, as determined jointly by the surface management agency and the Fish and Wildlife Service, shall be considered unsuitable.

Exception. A lease may be issued where the surface management agency, after consultation with the Fish and Wildlife Service, determines that all or certain stipulated methods of coal mining will not adversely affect the migratory bird habitat during the periods when such habitat is used by the species.

Analysis

The following list of migratory bird species of high federal and/or state interest are known, or considered likely, to breed and nest within the Elk Creek Tract or vicinity:

Bank-tailed pigeon
Black swift
Cooper's hawk
Flammulated owl
Golden eagle
Great blue heron
Loggerhead shrike
Lewis' woodpecker
Peregrine falcon
Prairie falcon
Western bluebird
Williamson's sapsucker
Northern goshawk
Three-toed woodpecker

Also, a total of eighty-six species of neotropical migrant birds are known to breed or migrate regularly through some part of Colorado. Recent studies in Colorado conclude that 41% of these neotropical migrant species are declining in numbers. The study also showed that riparian communities, followed by Gambel oak communities support the highest number of breeding birds.

Underground coal mining would impact these species to the degree that the human and surface-disturbing activities would impact their breeding and nesting activities and habitats in riparian and Gambel oak communities. Of particular high importance are the riparian areas throughout the review area, specifically in Hubbard Creek, Bear Creek, and Elk Creek. Riparian areas are suitable for coal leasing only with inclusion of the following special stipulation to protect the above mentioned migratory bird species:

1. A one-eighth mile buffer zone (660 feet) will be protected on either side of riparian zones (or a buffer zone may be established in accordance with the surface management agency guidelines).

2. No surface disturbances, except surface subsidence, will be permitted within these buffer zones, unless practical alternatives exist.

3. Other raptors (except American kestrel):

    a. Conduct surveys for nesting raptors on the lease tract prior to development of any surface facilities.

    b. No surface activities will be allowed within one-half mile radius of active nest sites between the dates of February 1 and August 15, unless authorized by the BLM or Forest Service on a site-specific basis.

4. All unavoidable surface disturbance will require approval of the Forest Service and BLM Authorized Officer. The BLM or Forest Service will coordinate with the Fish and Wildlife Service and the Colorado Division of Wildlife to determine the type and extent of allowable variances. A site specific analyses will determine if this stipulation will apply.

Criterion 15

Federal lands which the surface management agency and the state jointly agree are habitat for resident species of fish, wildlife and plants of high interest to the state and which are essential for maintaining these priority wildlife and plant species shall be considered unsuitable. Examples of such lands which serve a critical function for the species involved include: (i) active dancing and strutting grounds for sage grouse, sharp-tailed grouse, and prairie chicken, (ii) winter ranges crucial for deer, antelope, and elk, (iii) migration corridor for elk, and (iv) extremes of range for plant species.

Exception. A lease may be issued if, after consultation with the state, the surface management agency determines that all or certain stipulated methods of coal mining will not have a significant long-term impact on the species being protected.

Analysis

According to GIS data obtained from the Colorado Division of Wildlife, portions of T13S, R91W, 6th PM, Sections 1 and 12, and T13S, R90W, 6th PM, Sections 6 and 7 are mule deer winter range, and all but the extreme northern end of the tract is elk winter range. No crucial winter range for mule deer is located on the tract. Crucial winter range for elk is located in portions of T13S, R91W, 6th PM, Section 12 and in T13S, R90W, 6th PM, Sections 5 and 6. Surface disturbing activities in this area caused by underground coal mining would impact elk and mule deer winter ranges. Forest Service data indicates that Bear Creek, Elk Creek, and Hubbard Creek are migration corridors for elk. The Elk Creek Tract is suitable for coal leasing only with inclusion of the following special protective stipulations on those areas designated as crucial winter range during the life of the project, and for migration corridors for elk:

> Coal related facilities and surface disturbances except subsidence will be authorized in the Elk Creek Tract only if no practical alternatives exist. The BLM and Forest Service will coordinate with the Colorado Division of Wildlife to determine the type and extent of allowable variances. Coal exploration, facility construction, and major scheduled maintenance will not be authorized within crucial winter ranges from December 1 through April 30. All unavoidable surface disturbances within the crucial winter ranges during these times will require approval of the BLM and the Forest Service Authorized Officer. No surface facilities may be constructed in the stream/riparian corridors on the lease tract within a one-eighth mile buffer zone on either side of Hubbard Creek, Bear Creek, or Elk Creek, in order to protect migration corridors. Surface disturbance within the one-eighth mile riparian buffer zone will not take place from December 1 through April 30.

No other federal lands within the Elk Creek Tract, or off-site that would be effected by the proposed action are considered critical or essential habitat for resident species of fish, wildlife or plants of high interest to the state of Colorado.

Criterion 16

Federal lands in riverine, coastal, and special floodplains (100 year recurrence interval) on which the surface management agency determines that mining could not be undertaken without substantial threat of loss of life or property shall be considered unsuitable for all or certain stipulated methods of coal mining.

Analysis

The Elk Creek Tract is not within a riverine, coastal or special floodplain.

Criterion 17

Federal lands which have been committed by the surface management agency to use as municipal watersheds shall be considered unsuitable.

Analysis

None of the lands in the propcsed lease tract are within a municipal watershed.

Criterion 18

Federal lands with National Resource Waters, as identified by states in their water quality management plans, and a buffer zone of federal lands one-quarter mile from the outer edge of the far banks of the water, shall be unsuitable.

Analysis

None of the lands in the proposed lease tract are identified as a National Resource Water.

Criterion 19

Federal lands identified by the surface management agency, in consultation with the state in which they are located, as alluvial valley floors according to the definition in Subpart 3400.0-5(a) of this title, the standards of 30 CFR Part 822, the final alluvial floor guidelines of the Office of Surface Mining Reclamation and Enforcement when published, and approved state programs under the Surface Mining Control and Reclamation Act of 1977, where mining would interrupt, discontinue, or preclude farming, shall be considered unsuitable. Additionally, when mining federal land outside an alluvial valley floor would materially damage the quantity or quality of water in surface or underground water systems that would supply alluvial valley floors, the land shall be considered unsuitable.

Analysis

The application lands are not within an alluvial valley floor, but such lands drain into the North Fork of the Gunnison River, along with both surface irrigated and potentially irrigable sites exist. However, material damage to the quality and quantity of water arising on or flowing over the proposed lease tract is not anticipated.

Criterion 20

Federal lands in a state to which is applicable a criterion (i) proposed by the state or Indian tribe located in the planning area, and (ii) adopted by rulemaking by the Secretary, shall be considered unsuitable.

Analysis

This criterion is not presently in effect in the state of Colorado.

SUMMARY

The Elk Creek Tract was determined to be suitable for coal mining following the application of Unsuitability Criteria Numbers 3, 4, 5, 6, 7, 8 10, 13 16, 17, 18 19 and 20.

Criterion Numbers 1, 2, 9, 11, 12, 14 and 15 were found to be unsuitable for mining, however, after applying the exceptions to the criterion, they were suitable for mining with the following restrictions:

Criterion 1: The lands within Section 35, T12S, R91W, and Section 32, T12S, R91W, 6th PM were proclaimed National Forest on June 6, 1905 and are within the Gunnison National Forest. These lands are considered suitable for coal mining after applying the exception to Criteria 1.

Criterion 2: There is a right-of-way for a powerline and road (COC-41183) located on the application lands managed by the BLM. The right-of-way is authorized to Oxbow and used for mining purposes. Lands involved in this right-of-way are suitable for coal leasing after applying the exceptions to the criteria.

Criterion 9: For water depletions, as part of the Mine Permit Application Package, the lessee shall furnish to the Regulatory Officer at the Office of Surface Mining an estimate of the average annual water depletion resulting from the proposed action. Consultation with the Fish and Wildlife Service may be required for any planned depletions. Conservation measures for the depletion will be determined during consultation. Conservation measures may include a one time payment, per acre-foot, to the Recovery Program at a fee to be established by the Fish and Wildlife Service. Arrangements for receiving the remitted funs from the lessee will be coordinated directly with the lessee by the Office of Surface Mining.

No surface disturbance or facilities will be located in occupied southwest willow flycatcher habitat. Prior to any planned disturbance within riparian habitats on the lease, the lessee must: 1) Survey the area of the proposed disturbance for suitable southwest willow flycatcher habitat, and survey all suitable habitat for the presence of the species. All habitat and species surveys must be in accordance with the accepted Fish and Wildlife Service protocol; 2) Provide the results of all surveys to the Fish and Wildlife Service, the Montrose District of BLM and the Paonia Ranger District or the Forest Service; 3) If suitable habitat or individuals are located in the area, consultation with the Fish and Wildlife Service will be required to determine suitable conservation measures to prevent a "take" under Section 9 of the Endangered Species Act. Conservation measures may include avoidance of the occupied habitat, establishment of a buffer zone and seasonal restriction around occupied habitat, or others developed for the specific site. In accordance with current protocol, surveys for the presence of the species are valid for only one year.

Criterion 11: With respect to bald or golden eagle nests which may be established on the Elk Creek Tract during the life of the project, the following special stipulations shall be applied:

1. No new permanent surface facilities or disturbances except subsidence shall be located within a one-quarter mile radius buffer zone around each bald or golden eagle nest site.

2. No surface ground activities will be allowed within a one-half mile radius buffer zone around each bald eagle active nest site from November 15 to July 30, and around each active golden eagle nest site from February 1 to July 15.

3. Any proposed surface facilities, disturbances or activities (as noted above) in, or adjacent to, these buffer zones will require approval from the BLM or Forest Service on a site-specific basis, after consultation with the Fish and Wildlife Service.

Criterion 12: With respect to bald or golden eagle roost sites or concentration areas which may be established on the Elk Creek Tract during the life of the project, the following special stipulation shall be applied:

1. No surface ground activity except subsidence shall occur within one-quarter mile radius of winter roosts between November 15 and March 15, development may be permitted at other periods. If periodic visits are required within the buffer zone after development, activity should be restricted to the hours of 10:00 a.m. and 2:00 p.m. from November 15 through March 15.

Criterion 14: Riparian zones are present within the Elk Creek Tract and are suitable for coal leasing only with inclusion of the following special stipulations to protect resident and migratory bird species:

1. A one-eighth mile buffer zone (660 feet) will be protected on either side of riparian zones (or a buffer zone may be established in accordance with the surface management agency guidelines). No surface disturbances, except surface subsidence, will be permitted within these buffer zones, unless no practical alternatives exist. All unavoidable surface disturbance will require approval of the Forest Service or BLM Authorized Officer. The BLM or Forest Service will coordinate with the Fish and Wildlife Service and the Colorado Division of Wildlife to determine the type and extent of allowable variances. A site specific analyses will determine if this stipulation will apply.

2. With respect to other raptors (except American kestrel) which may occur or become established on the Elk Creek Tract during the life of the project, the following special stipulation shall apply:

    > Conduct surveys for nesting raptors on the lease tract prior to development of any surface facilities. No surface activities will be allowed within one-half mile radius of active nest sites between the dates of February 1 and August 15, unless authorized by BLM or Forest Service on a site specific basis.

Criterion 15: If areas are determined by the Colorado Division of Wildlife to be mule deer and elk crucial winter range, and for the protection of migration corridors for elk, the following stipulation shall be applied:

Coal related facilities and surface disturbances except subsidence will be authorized in the Elk Creek Tract only if no practical alternatives exist. The BLM and Forest Service will coordinate with the Colorado Division of Wildlife to determine the type and extent of allowable variances. Coal exploration, facility construction, and major scheduled maintenance will not be authorized within these crucial winter ranges from December 1 through April 30. All unavoidable surface disturbances within these crucial winter ranges during these times will require approval of the Authorized Officer. No surface facilities may be constructed in the stream/riparian corridors on the lease tract within a one-eighth mile buffer zone on either side of Hubbard Creek, Bear Creek, or Elk Creek, in order to protect migration corridors. Surface disturbance within the one-eighth mile riparian buffer zone will not take place from December 1 through April 30.

REFERENCES

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Colorado State Statutes, 1988. Division of Wildlife and Division of Parks and Outdoor Recreation, Title 33, Chapter 10, Article 11 and 111.

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U.S. Department of the Interior, 1983. Uinta-Southwestern Utah Coal Region Environmental Impact Statement, U.S. Department of the Interior, Bureau of Land Management, Utah State Office, Salt Lake City, Utah.

U.S. Fish and Wildlife Service, 1992. Informal Section 7 Consultation, Western Colorado Suboffice, Grand Junction, CO.

CONSULTATION AND COORDINATION

The following agencies and organizations were contacted to gain information pertinent to the application of the twenty coal suitability criteria:

Federal Agencies

U.S. Department of the Interior
Fish and Wildlife Service

U.S. Department of the Interior

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Office of Surface Mining

Colorado State Agencies

Division of Wildlife, Southwest Region Office, Montrose, CO
Colorado Division of Minerals and Geology

County Agencies

Delta County Planning Department
Gunnison County Planning Department

Appendix E

Mining Economics

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APPENDIX E
MINING ECONOMICS

The evaluation of a coal mining project is a complex and detailed activity. It involves the interaction of mining engineering with finance and economics in the analysis of whether a coal mine is economically viable to shareholders and investors.

Mine evaluation involves the assessment of a variety of factors and variables that are essential in establishing the worth of the coal mining project. In determining the economic viability of a coal mining project, estimates of coal reserves, mining rates, revenues, costs, expected returns, and associated risks must be made.

The mine evaluation procedure is iterative in nature. The estimated coal reserves, as established from an exploration program, are the starting point in determining mine size and production. In turn, mine size affects production cost (both capital and operating expenses), as economics of scale are typically enjoyed with larger production rates. Ultimately, project production costs determine the amount of coal that can be mined at a profit and therefore determines the magnitude of the annual production rate.

It is important to remember that each time a variable changes in the mine evaluation procedure, the impact of this change on the other variables must be assessed, as well as the effect on subsequent financial and economic results. The iterative procedure will be repeated to determine the most economic design. This is a time-consuming process.

Further, it is important to remember that coal can be mined only when it is sold, usually under a contract with an electric utility. In the metal mining business (e.g., gold, copper), a diverse market exists in response to the supply and demand conditions. Consequently, if the metal can be mined, it can be readily sold. In the coal mine business, the market is more constrained. Generally the coal is only sold when the coal producer (the mining company) and the end user (often an electric utility) can negotiate a sale. This sale is usually on a contract basis. This fact leads the coal mine planners to make assumptions and predictions regarding the range of production that might occur.

The investment environment associated with the coal mining industry, is unique when compared to most other industries. The following describes some of the special features associated with the economics of the coal mining industry.

1.0 CAPITAL INTENSITY

Coal mining ventures are extremely capital intensive, especially underground coal mining operations which utilize longwall technology. Even small coal mining operations that require a limited workforce may require multi-million dollar investments.

2.0 COST STRUCTURE

The total average cost of coal mine production includes a high-fixed cost component that primarily reflects capital cost recovery. For this reason, the break-even production level for coal mining operations is closer to capacity than for other types of industrial operations with lower fixed costs. This is the major reason that for coal mine operations run at or near capacity, often employing seven-day per week work schedules.

3.0 LONG PRE-PRODUCTION PERIODS

Even after the occurrence of a coal reserve has been established, several years of intensive effort can be required to develop the operation. The pre-production period depends on the coal mining and handling methods, size and location of the deposit, and the complexity of the regulatory framework.

The importance of long lead times is amplified when considered in conjunction with the capital intensive nature of the coal mining industry. Not only are coal companies committing extremely large capital resources to a new or expanded mining venture, but they are also exposed financially for a certain period prior to project start up. Also, since capital expenditures are required throughout the pre-production period, the longer the lead time, the greater are the returns required to offset the lost investment opportunities represented by the pre-production period. In the case of longwall operations, development must be undertaken in order to establish or "block out" the panels required for longwall operations. See *Appendix F, Overview of Underground Coal Mining.*

4.0 NON-RENEWABLE RESOURCES

Unlike most other industries, one unique aspect of the coal mining industry is the extraction of a non-renewable resource. Mining revenues result from the "disposal" of the project's main asset, the coal reserve. As a result, the return of and return on the capital investment must be obtained within the finite life of the coal reserve block.

5.0 RISK

Besides the risks associated with capital intensity and long pre-production periods, mining operations are subject to economic or market risks, geologic and engineering risks, and political and regulatory risks.

Economic or market risks are typically outside the control of the operation; these include fluxuating coal prices, inflation, lack of long-term coal contracts, and generally unpredictable future economic conditions.

Technical risks (geologic and engineering) have been notably reduced in recent years with improvement in planning methods and tools.

Often underestimated, political and regulatory risks have been increasingly important in recent years when considering coal mining investments. There is an accelerating trend to greater political participation and regulatory oversight in coal mining projects.

6.0 COAL MARKETS

Coal markets are volatile. In the 1970s, coal customers often signed up for lengthy long-term contracts (15 to 20 years). However, the current trend with coal contracts involves relatively short contracts (1 to 5 years). In addition, there are literally thousands of factors that effect coal markets and prices. Some are economic, like traditional supply and demand theories; others are political, such as decisions made by federal, state, and local governments with regard to taxation and regulation. Even the most experienced and sophisticated observer of coal markets is likely to err in predicting the future course of coal demand and prices.

Appendix F

Overview of Underground Coal Mining

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APPENDIX F
OVERVIEW OF UNDERGROUND COAL MINING

1.0 INTRODUCTION

Coal mining involves the extraction of coal deposits. Although the thickness of a coalbed may vary, minable deposits generally are continuous over large areas. When the deposit is close to the ground surface (less than 200 feet deep), it is generally mined using surface methods. Deeper deposits are generally mined by underground methods.

Geologic strata above and below the coal deposit are known as overburden and underburden, respectively. The overburden and underburden strata that are actually in contact with coal in an underground mine are called the "roof" and "floor," respectively. Blocks of coal left in place to help support the roof of the underground mine are called "pillars."

Removal of coal by underground methods creates a void in the stratigraphic column. As a block of coal is extracted, natural forces act on the stability of the overburden and cause the column to subside. Even in the strongest formations, large, artificial underground openings will eventually be filled by the collapse and compaction of overburden and pillars. Underground coal mining methods are generally classified or distinguished from each other by the type of support used to prevent the roof from collapsing prematurely on workers and equipment.

2.0 ROOM-AND-PILLAR MINING OPERATIONS

Room and pillar mining is a type of underground extraction used in near horizontal coal deposits where the roof is supported primarily by pillars. Coal is extracted from rectangular shaped rooms, or entries, in the coal seam. Parts of the coal seam are left between the entries and serve as pillars to support the roof. The pillars are arranged in a regular pattern, or grid, to simplify planning and operation. Pillars can be of any shape but are usually square or rectangular. The dimensions of the rooms and pillars depend on many design factors, including the stability of the roof, the strength of the coal in the pillars, the thickness of the coal seam, and the depth of mining.

Typically, coal seams mined by underground techniques in the United States range in thickness from 2.5 to 15 feet. For roof control and safety reasons, the width of the rooms, or entries is generally limited to 20 feet. The spacing, or centers, between entries varies from 40 to 100 feet depending on the stress distributions determined in the design and operation of the mine. Spacing between crosscuts is limited by ventilation concerns and is usually specified by federal and/or state safety laws (approximately 100 feet). A general representation of room and pillar mining is shown in *Figure F-1, Conceptual Room and Pillar Mining*.

In underground coal operations, there are two types of room and pillar mining:

- Conventional room and pillar mining
- Continuous room and pillar mining

Conventional mining involves a cyclical system of extraction, employing mobile equipment to conduct the production cycle of operations as follows:

- Undercut coal face
- Load holes with explosives
- Blast
- Load coal
- Roof bolt

In continuous room and pillar mining, the separate unit operations of conventional mining are eliminated and performed by a high-performance continuous-mining machine. In the United States, most room and pillar mining is conducted using a continuous-miner system which includes:

- A coal extraction machine (continuous miner).
- A coal haulage system (shuttle cars and conveyor belts).
- A roof support system (roof bolts and pillars).

The continuous miner is electrohydraulically powered and track-propelled. Major components of this machine include a rotating-cutting drum, a gathering head beneath the cutting drum, and an internal conveyor. The machine operator drives the rotating-cutting drum which is situated at the front (head) of the machine into the coalbed and cuts coal from the coal face. The gathering head which is located beneath the rotating cutting drum shifts the cut coal to the conveyor for transfer to the rear (tail) of the machine. A rear, articulating conveyor then transfers the coal to independently-operated shuttle cars.

Shuttle cars (10 to 15 tons per car) are used to transport mined coal from the continuous miner to a conveyor belt transfer point within the mine. Shuttle cars are either electric- or diesel-powered, 2- or 4-wheel drive, and have either a conveyor or push-ram system to discharge the coal to the stationary conveyor belt which transports coal outside the mine portal, usually to a run-of-mine (ROM) coal stockpile.

Pillars and roof bolts are used to support the roof. Solid pillars of coal are left in place during the initial (advance) mining stage to provide basic roof support within each block of mined-out coal and along the main access corridors (entries) of the mine. Additional roof support is provided by the use of roof bolts. Roof bolts are long steel rods, drilled into place and then anchored to the roof rock by either a resin glue or a mechanical compression device. They create a supporting "beam" of rock by bonding or "bolting" several layers of rock strata together. The general mining/production sequence allows for the continuous miner to advance about 20 feet before the roof of the mined area is secured with roof bolts. Several continuous-miner sections (entries) are developed concurrently to allow for uninterrupted mining activity (i.e., while roof bolts are being installed in some entries, mining can continue in other entries), for safety, and for ventilation.

As a general rule, 30 to 60 percent of the coal remains in place in the form of pillars after the rooms are mined. To increase coal recovery, the roof can be temporarily reinforced with additional bolts so that those pillars not required for support of the main entries can be systematically removed. In this second stage of mining, pillars are removed (or "robbed") as the mining equipment "retreats" from each mined room. As pillar-robbing progresses, each mined-out block of rooms is allowed to cave in, and the mined area is abandoned.

3.0 LONGWALL MINING OPERATIONS

Longwall mining is an underground extraction method in fairly flat-lying, tabular coal deposits. A "long" face is established across a panel, which is blocked out on both sides by entries. These entries are known as the "headgate" entry and the "tailgate" entry. The headgate entry is used for the passage of intake air and the transportation of coal, personnel, and supplies, while the tailgate entry is used for the passage of the return air. A general representation of longwall mining is shown in *Figure F-2, Conceptual Longwall Mining*.

The longwall panel layout is simple and conducive to good ventilation, and crews always work under protective supported roof. Since the longwall system with caving leaves lessor amounts of residual pillars than other mining methods, coal recovery is higher. Depth of overburden for a longwall operation can vary from 200 to over 2,500 feet, with coal seam thickness ranging from 4 to 15 feet.

Panel width and panel length are usually determined by experience, based on the size and shape of the coal deposit, geologic conditions, and the capacities of the transportation, ventilation, and power equipment that can be supplied. in the United States, the panel width typically ranges from 500 to1,000 feet; panel length also vary, ranging from 3,000 to 15,000 feet.

While the width of the panel face, or wall, is measured in hundreds of feet, the actual working area is narrow, measured in feet. A longwall system is kept open, by a series of heavy-duty, electrohydraulically powered, yielding supports that form a cantilever or umbrella of protection over the face. As a cut, or slice, is taken along the panel face, the supports retract, advance and re-engage, allowing the roof to cave in the mined-out area behind the supports. The caved material is known as "gob."

A very old method, longwall mining originated in European coal mines in the seventeenth century and has widespread use in coal-producing countries outside the United States. Only since the 1960s, when self-advancing, hydraulic support systems were perfected, has longwall mining been accepted in the United States. Other innovations that have led to its growing use in coal fields are the development of mobile, flexible, armored conveyors, high-speed continuous mining machines (shearers), and roof control and caving practices grounded in sound rock mechanics principles.

Longwall mining operations in the United States is predominantly of the "retreating" type. That is, the headgate and tailgate entries are developed, and the longwall mining system "retreats" from the back of the panel toward main entries. See *Figure F-3, Typical Longwall Panel Layout in the United States*. Longwall development is strikingly similar to the development for room and pillar mining.

Longwall operations in the United States are conducted with a longwall mining system. As with the continuous miner, the longwall system will include:

- A coal extraction machine (shearer).
- A coal haulage system (face conveyor).
- A roof support system (shields).

Whereas the continuous-mining system involves several independently operated pieces of equipment to mine coal, the longwall mining system is totally integrated, with all of the necessary equipment interconnected. For example, the longwall mining system, the shearer actually moves along the face conveyor and the shields are physically connected to it.

The shearer, like the continuous miner, is electrohydraulically powered. The major components of this machine are the rotating-cutting drums and the tram system. The drums, located at each side of the machine, are limited to an up-down movement. The machine operator drives the rotating-cutting drums into the coalbed as the machine trams laterally along the face conveyor, thereby cutting coal from the coal face. Cut coal falls to the floor-supported face conveyor for transport to the end of the longwall, the "headgate." There, the coal is transferred to another conveyor belt that transports the coal outside the mine portal. The end of the conveyor opposite the headgate is known as the "tailgate."

Longwall roof support is temporarily provided by the use of hydraulic roof supports (shields). Major components of the shields include canopy, hydraulic cylinder, hydraulic controls, and the base. The canopy is a thick, reinforced-steel plate that is pushed against the roof by hydraulic cylinders to support the weight of the overburden while coal removal operations continue below. Shields are generally 5 feet wide, vary from 4 to 15 feet high, and have a design-load capacity of 500 tons or more per shield. The base length of the shield is relatively short, allowing the face conveyor to sit on the floor in front of the base. Shields are designed to be large enough to safely cover the face conveyor, shearer, and workers. In the longwall system, individual shields are installed next to each other along the entire longwall face, from the face conveyor headgate to its tailgate. See *Figure F-2, Conceptual Longwall Mining*.

The mining/production sequence involves cutting (shearing) a section of coal face, typically 30 to 42 inches deep, from the headgate to the tailgate, using hydraulic rams to move the face conveyor up against the face of the fresh-cut coal seam. Hydraulic rams attached to the face conveyor then move individual shields forward. The unsupported roof behind the shields is allowed to cave to the floor. As the block of coal is systematically removed, the mined area is gradually abandoned.

4.0 MECHANISMS OF SUBSIDENCE

Removal of coal deposits by underground mining methods creates voids that are filled when natural forces weaken the overburden and it collapses. The collapse of overburden into the void and the translation of this movement to the surface are known as subsidence. Subsidence-related deformation of rocks above underground mines can consist of fragmentation, fracturing, sagging, and bedding-plane separation. However, caving of the overburden into mined areas does not always translate into surface subsidence. The type of deformation that occurs, and whether the deformation reaches the surface, depends on a number of factors, including rock type, rock strength, mine layout, mine depth, and how far a particular horizon lies above the void in the mined area. The magnitude, extent, and duration of subsidence can be minimized by an efficient mine layout, proper barrier and pillar design, and a rapid and efficient mining system.

4.1 Subsidence-Related Deformation

In the overburden above mined areas, three zones of deformation tend to develop in response to subsidence, as shown on *Figure F-4, Conceptual Representation of Subsidence Deformation Zones*. In the fragmented zone, rocks of the immediate roof are expected to fragment, cave, and rotate. This zone can be as much as ten times thicker than the void produced by mining (the mining height). Directly above, in the fractured zone, rocks are expected to fracture and deform, but they should maintain their continuity. Bedding-plane separations can occur. This zone can be as much as 50 times thicker than mining height. In the third zone, the deformation zone (which some scientists separate into two zones), rocks should sag downward without major fracturing, but bedding-plane separations and surface tension cracks can still occur. This zone can extend from the top of the fractured zone to the ground surface. After the deformation process, fractures that developed in the softer sandstones and shales tend to close, while fractures that developed in more brittle rocks may remain open.

If deformation reaches the surface, subsidence will typically appear as basins or depressions, pits, and/or cracks. Subsidence basins can form above room-and-pillar mines where the pillars have been robbed or above longwall mines. These basins are typically elliptical or trough-shaped because the rooms or panels are large and rectangular, and coal seams often are nearly horizontal. Subsidence pits can form above room-and-pillar mines where the pillars have been retained because the overburden directly above the pillars continues to be supported, while the overburden above the mined area collapses into the mined-out rooms.

Horizontal strain, both tensile and compressive, results from lowering of the surface during subsidence. Tension that can cause cracks occurs as the surface begins to subside and stretch. Compression takes over and closes some of the tension cracks as the ground begins to settle. Corresponding changes in surface slope generally are temporary and commonly have a magnitude of less than 3 degrees. Tension cracks are more apparent than compression features because rocks are stronger in compression. Tension cracks are more abundant in solid rock than they are in unconsolidated materials. At the surface, tension cracks can range from small (less than an inch), subtle features that are difficult to recognize to fractures that are several feet wide and several feet deep. Surface fractures may be temporary, with many closing during successive subsidence events, after natural deposition of sediment, or when frost heaving fills them. Tension cracks over the edges of the mined area (the mining boundaries) may remain open indefinitely. This is most evident in areas where brittle sandstones or other rocks crop out. The surface soil cover will have an influence on the cracking that is actually visible at the surface. Unconsolidated deposits of alluvium, colluvium, and soil tend to obscure surface cracks.

4.2 Factors Controlling Subsidence

Several factors control the area, amount, rate and duration of subsidence. Mining factors include mine geometry, extraction ratio, mining method, height of the mine workings, and mining rate. Geologic factors include thickness of the coal deposit, along with the thickness, lithology, strength, structure, and bulking (or swell) factor of the overburden. The subsidence factor and the angle of draw are used to describe the maximum vertical displacement and the areal extent of subsidence, respectively.

The mine geometry (or mine design) determines the size and configuration of the rooms, pillars, and panels; the height of the openings and pillars; and the spatial relation to any abandoned mines that may be located above the active mine. Generally, mines are designed so that the subsidence process can take advantage of joints in the overburden. This can minimize sagging of the immediate roof and promote rapid roof collapse. Although subsidence can be reduced by leaving pillars for support, this procedure may only delay subsidence because pillars and roof rocks generally yield with time and weathering.

The extraction ratio is the ratio of the amount of coal extracted to the total amount of coal in the deposit. Longwall mining, because it extracts nearly 100 percent of the coal within a longwall panel, generally achieves an overall extraction ratio in excess of 80 percent of the total coal deposit. Room-and-pillar mining rarely extracts more than 55 percent of the total resource, but pillar robbing upon retreat from a mine has the potential to extract nearly as much of the coal as does longwall mining.

The mining method also influences the amount of subsidence. Longwall mining results in more subsidence than room-and-pillar mining, principally because of its greater extraction of coal. Efficient robbing of pillars, however, can result in surface subsidence nearly equal in magnitude to that associated with longwall mining. Subsidence above room-and-pillar mining areas is also less predictable and more variable in surface expression than above longwall panels because the extraction ratios and heights of caving are more variable.

The mining rate affects subsidence, too. When the mine face is extracted at an even and rapid rate, smoother subsidence profiles occur with less differential movement.

Thickness of the coal deposit, thickness of the overburden, and height of the mine workings control maximum subsidence. The subsidence factor is the ratio of maximum surface subsidence to the seam mining height and is often expressed as a percentage. For example, if 7 feet of subsidence occurred over a mine with a 10-foot mining height, then the subsidence factor would be 70 percent. In the Western United States, subsidence factors range from about 45 to 90 percent of the thickness of coal. The angle of draw identifies the limits of subsidence beyond the boundaries of the mined area (the areal extent of subsidence occurring at the ground surface will be larger than the underground void). It is expressed in degrees from vertical above the edge of the mined area. For example, if the angle of draw were 20 degrees and the overburden were 500 feet thick, then subsidence could occur as much as 182 feet beyond the edge of the mined area. In the Western United States, subsidence angles of draw range from about 5 to 30 degrees.

Sagging, caving, and fragmentation are governed by the strength and structure of the overburden. The composition of the mineral grains and the cements that bind the grains together affect the strength of the rocks. Existing faults and fractures in the overburden offer good sliding surfaces that can influence the angle of draw. The strength and structure of the overburden rocks are considered when determining room, pillar, and panel orientation.

The bulking factor, or the volumetric increase of fragmented rocks relative to their undisturbed and in-place volume, is a major factor influencing subsidence. The bulking factor is determined by the size and shape of the broken rocks, the contact stresses among rock fragments within the fragmented zone, and the relative strengths of the affected rocks. Bulking factors generally are lowest where the overburden is composed of soft claystones and thinly bedded shales, and greatest where hard, thickly bedded to massive sandstones and limestones predominate. If rock fragments randomly fall to the floor of the mined area, and if strong, massive rocks occur in the fractured and deformation zones, then the bulking factor is higher. Higher bulking factors in the overburden result in less vertical movement of the rocks and in reduced tension and compression at the surface.

4.3 Prediction of Subsidence

Subsidence associated with underground mining is anticipated, and its magnitude and extent can be predicted. Often, predictions of maximum surface subsidence and horizontal tensile and compressive strains are used to help assess the secondary impacts to other resources (both human and natural). Data collected during actual subsidence are used to verify prefixing predictions.

A method of calculation developed by the British National Coal Board offers one of the most comprehensive, conservative, and accurate techniques for predicting subsidence and surface strains. Other researchers have modified it for the stronger strata of coal mines in the Western United States. Inputs to the subsidence prediction model are depth, mining height (seam thickness), and room or panel geometry.

Subsidence profiles can be used to illustrate subsidence and strain predictions above a mined area. Diagrams A, B, and C of *Figure F-5, Example of Subsidence and Strain Profiles*, shows a cross-section of a longwall mine and the subsidence and strain profile that might be expected to develop over two mined-out longwall panels. In this example, the longwall panels are 800 feet wide, overburden is about 780 feet thick, mining height is 13.5 feet, the subsidence factor is 70 percent, and angle of draw is 22.5 degrees. Under these conditions, the maximum final surface subsidence would be 9.8 feet, which would occur over the middle of each panel. Final subsidence over the pillars between two panels, while not reaching the maximum, would still be about 5 feet.

In diagram B, the dashed line indicates the limit of subsidence resulting from a single panel, and the upper solid line represents the extent of subsidence (about 25 feet) immediately after mining the adjacent panel. The lower solid line represents the maximum final subsidence over the pillars after they have collapsed under the weight of the overburden.

Diagram C shows the compressional strain that occurs above the panels and the tensile strain that occurs at panel boundaries and over pillars as the strata flex and stretch downward into the subsidence trough. In this example, the tensile strain exceeds the strain criterion in areas above the panel boundaries and the pillars; surface cracking would be predicted in these areas, with larger maximum tensile strains possibly resulting in wider cracks. The exact location and actual width of open surface cracks is unpredictable.

A monitoring program is generally implemented at underground mines to collect subsidence data. These data are used to verify the accuracy of the predicted subsidence under actual ground conditions and to detect mining induced impacts to surface resources, both predicted and unpredicted. In addition, site-specific angle of draw, subsidence factor, and tensile strains may be calculated. These results can be used to refine the predictive model, which then can be used to estimate the effects of mining in successive longwall panels during the remainder of the mine life.

A number of techniques and types of equipment can be used in subsidence monitoring programs: conventional ground surveying of monuments located over panels and extending out over unmined areas; installation of extensometers to measure horizontal strain; serial photographic surveying; analytical aerial triangulation; digital terrain modeling; surface observations; and well, surface water, and spring monitoring. To be effective, monuments must be constructed so they are unaffected by movements unrelated to subsidence, such as soil heave due to freezing.

4.4 The Subsidence Event

Subsidence, when load of the overburden is high compared with the rock strengths (that is, when the mined seam is fairly deep), may be summarized as follows:

- Sufficient coal is removed to open up the mine void, and the roof support system is withdrawn or advanced. The immediate roof is fragmented and "bulks" into the mined area, and a percentage of the mining height (i.e., the subsidence factor) subsides all the way to the surface. The surface sags downward behind the advancing front of the longwall mining activity or the retreat (when pillars are robbed) in room-and-pillar mining activity. The subsidence trough formed at the surface (controlled by the angle of draw) is wider than the mined areas.

- The advance of the longwall mining activity or the retreat (when pillars are robbed) in room-and-pillar mining activity also extends the deformation in the overburden. As the overburden rocks bend into the subsidence trough, new ground is placed in tension and new fractures open up. As the mining face passes under and progresses away from a particular point, the area of tensile stress moves away as well. Settling, accompanied by compression, takes over behind the area of stress, and the tensional fractures tend to close. As successive areas are mined, this activity takes the form of a smooth subsidence wave. Pillars collapse under the overburden load when panels or rooms are mined on both sides of those pillars. This collapse can help smooth out surface irregularities and close some of the remaining surface cracks. Massive sandstones in the overburden can also assist in smoothing out irregularities when they act as "beams" and produce a more complete collapse of pillars.

- Subsidence movement over longwall mines and over room-and-pillar mines where pillars have been robbed tends to be relatively short-lived. Ninety to 95 percent of the subsidence is expected to occur once coal extraction in an area is complete. Residual subsidence should occur within two to five years after mining has ceased. Some delayed subsidence may occur over pillars that deteriorate slowly.

- Subsidence movement is much slower over room-and-pillar mines where pillars have been left behind, depending on the design and height of the pillars and how much overburden weight rests on each pillar. Eventually, even the strongest pillar will deteriorate and collapse.

Where a mined area is fairly shallow and massive sandstones in the roof provide some support to the overburden load, subsidence can occur abruptly with the entire load falling as a unit. Here, the surface expression may not be as smooth as that previously described, and larger cracks could result.

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Appendix G

Historic Coal Mining Activity

APPENDIX G
HISTORICAL COAL MINING ACTIVITY

Coal was discovered in the North Fork of the Gunnison River valley in the early 1880s. Commercial coal mining on a large scale in the region began near Somerset at the Utah Fuel Corporation Somerset Mine in 1903. The Denver and Rio Grande Western Railroad constructed a railroad to service this Utah Fuel operation. The area around Somerset became one of Colorado's most important coal producing regions on the western slope. The location of the historic mining operations and the extent of their coal extraction is shown on *Figure 3, Historic Coal Mines and Federal Coal Lease Locations*, found in the attached volume of EIS figures.

For the past 100 years, numerous coal mining operations have been developed and operated in the valley. Some operations were small, operating only during the winter, with miners working the orchards during the summer. Other operations were large, on a relative scale for their day.

Utah Fuel Corporation (later U.S. Steel) shipped their coal to Utah for use as coke in the steel making process in steel mills. Other coal produced from the mines in the region was used for domestic heating in local western slope towns and communities. Still, other coal production has been shipped to electric utilities, cement plants, and miscellaneous industrial users.

The steady expansion of population in the Somerset and Paonia area because of the coal mining activities also created a local market for agricultural products. Also the railroad, constructed to ship coal, brought ranchers and farmers into contact with distant markets. Along with coal mining, the main economic base of the area during the century has been ranching and farming.

Coal mining in the valley always has been influenced by markets and coal prices. In the 1980s, coal prices showed weakness and many of the mines closed or curtailed operations. In recent years, although coal prices remain relatively low, there has been increased interest in the coal in the North Fork of the Gunnison River valley as a "clean-compliance" coal for electric power generation. This use is attributed to its high BTU and low sulphur content.

This appendix provides an overview of historic mining operations located in the North Fork of the Gunnison River valley. Most of the information on these mines was obtained from the files of the Colorado Division of Minerals and Geology.

Bear No. 1, No. 2, and No. 3 Mines

Tony Bear opened the Bear No. 1 Mine in 1932. The Bear No. 1 Mine is located in the SW¼, SE¼, Section 9, T13S, R90W. The Bear No. 2 portals were opened approximately 1,000 feet west of the Bear No. 1 portal. The Bear No. 1 and No. 2 Mines operated in the B and C seams, and from 1932 until their closure in 1980, these operations produced a total of 3,814,164 tons or an average of 100,374 tons per year. Coal production from the Bear No. 1 and No. 2 Mines varied from early pick and shovel operations with a production of only 1,283 tons in 1932 to a high production output of 250,152 tons in 1979.

Using continuous room and pillar mining techniques, from 1968 to 1980, the Bear No. 1 and No. 2 Mines produced 2,188,873 tons of coal, or an average of 182,406 tons. In 1981, the portals

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were sealed, surface facilities removed, and the area regraded and seeded. At the same time, Bear Coal Company purchased the old Edwards mining property and developed the Bear No. 3 Mine. The portals for the Bear No. 3 Mine were located in the SE¼, SE¼, Section 8, T13S, R90W. The Bear No. 3 Mine operated from 1981 through 1996 producing a total 2,136,345 tons, for an annual average production of 213,635 tons. The Bear No. 3 Mine was closed in 1996, the portals were sealed, and reclamation at the site began.

A unique historical aspect of the Bear No. 1, No. 2, and No. 3 Mines is the fact that they were run by a single family operation, the Bear Coal Company, originally Tony and Virginia Bear, and later their son William Bear. Four generations of the Bear family worked at these operations.

Blue Ribbon Mine

The old Blue Ribbon Mine operated from 1952 until 1963 and was located in the NE¼, NW¼, Section 2, T13S, R91W. During that time, the mine produced only 35,805 tons, or an average of approximately 3,255 tons per year. The mine produced coal for local markets using a conventional "cut and shoot" method. The old Blue Ribbon Mine produced from the E seam or the "Hawk's Nest" seam.

The modern day Blue Ribbon Mine was located immediately adjacent to the old Blue Ribbon Mine. It operated from 1977 through 1985. During that time, the mine produced 922,858 tons, or an average of 115,357 tons per year. The mine was closed and reclaimed in 1986. The mine produced coal with modern continuous miners. Coal was transported from the face with electric shuttle cars. Belt conveyors were used to transport the coal to the surface. Electric power was supplied to the mine by on-site diesel generators. Like its predecessor, the mine produced from the E seam or "Hawk's Nest": seam.

Bowie No. 1 Mine and Coal Loadout

The Bowie No. 1 Mine and the Bowie No. 1 Coal Loadout were originally developed and operated by Colorado Westmoreland Inc. as the Orchard Valley Mine and Loadout. In 1994, these facilities were sold to Cyprus Coal Company who operated the mine until 1997, whereupon it was sold to Bowie Resources, Ltd. The Bowie No. 1 Mine is presently idle, with no coal production from this mining operation since 1996. The mine was operated as a room and pillar operation, and has a capacity to produce approximately 1.5 million tons of coal per year. When operating, the coal was hauled from the mine portal area to the coal loadout facility near Paonia.

The Bowie No. 1 Coal Loadout was constructed by the Colorado Westmoreland Inc.. This facility is presently receiving coal from the Bowie No. 2 Mine. Coal is hauled currently to the loadout with highway trucks under a contract between Bowie Resources, Ltd. and Savage Trucking, Inc. The Bowie coal loadout includes a truck dump area, conveyors, three silos with a capacity of 7,000 tons each, and a batch loadout tower for loading railroad cars.

Bowie No. 2 Mine

The old King Mine and associated facilities were purchased from Adolph Coors Company by Bowie Resources Ltd. in 1996. Bowie developed a new portal facility on the D seam, designated as the Bowie No. 2 portal. The mine presently uses room and pillar mining techniques, but plans to install a longwall system in 1999. The mine produced 1.2 million tons of coal in 1998; but, with the new longwall system, production could be increased up to 5 million tons per year. The coal removed from the Bowie No. 2 Mine is presently loaded on trucks and hauled to the Bowie No. 1 Loadout. The Bowie No. 2 portals are located in the SW¼, SW¼, Section 10, T13S, R91W.

Converse Mine

The old Converse Mine is located in the SW¼, NW¼, Section 24, T13S, R92W. This mine was originally opened to provide coal for local use and was operated from 1913 through 1936. The old Converse Mine produced only 15,801 tons during its life, averaging only 687 tons per year. The original mine was opened by Frank Converse and utilized pick and shovel mining methods.

The mining property remained idle until 1974, when the area was leased to Consolidated Coal Company who conducted some expansion activities on the tract. In 1976, the property was sold to Colorado Westmoreland Inc. and the Orchard Valley Mine was developed.

Edwards Mine

Underground coal mining activity south of the community of Somerset, Colorado across the North Fork of the Gunnison River began in 1934 with the opening of an underground operation owned by Mr. Clark and Mr. Blair. This mine was originally known as the Lone Pine Mine and in 1943, the mine was renamed the Edwards Mine. Coal mining from this operation continued over 30 years until the operation ceased in 1965.

The Edwards Mine production ranged from a low of 980 tons in 1935 to a high of 42,773 tons in 1945. Over its 30 year life, the mine produced a total of 381,350 tons from the B seam and 123,723 tons from the C seam, for a total combined production of 505,073 tons, or an average of approximately 15,783 tons per year. The mining site of the old Edwards Mine remained inactive from 1946 until 1981, when the property was bought by the Bear Coal Company and the Bear No. 3 Mine was developed.

The Clark Mine (Windjammer Mine) was operated by Mr. Clark and Mr. Blair from 1934 to 1942. The mine was re-designated the Edwards Mine in 1943 and was operated by George M. Edwards from 1943 through 1945. In 1945, the mine was sold to Paul R. Clark who owned the Clark Coal Company, and Mr. Clark operated the mine from 1946 through 1957. The North Fork Coal Corporation operated by B.R. Knoll and Partners, purchased the mine in 1958 and operated it until 1966, when the mine was closed.

Farmer's Mine

The Farmer's Mine was opened by Paonia area farmers in the early 1900s for use in local houses, in the schools and in a small Paonia power plant. The mine operated from 1911 until 1921 with a total production of 51,249 tons, or an average of 5,129 tons per year.

In 1959, the Emmons Brothers purchased the mine and operated it until 1965 when the local market declined. The highest production attained was approximately 25,000 tons in 1964. The upper D seam was mined by the pick and shovel method in the early years. Later, hand drilling and explosives were used. Hauling was by mules and four-horse wagon teams.

Hawk's Nest Mine

The Hawk's Nest Mine underwent an interesting evolution of operations. The first extraction of federal coal lands was by a group of ranchers for their own use in the early 1900s. They used a portal located in the NW½, SW¼, Section 12, T13S, R90W.

A small extraction of coal for ranching use went on until October 1922, when the Champion Coal Company was formed to expand the original ranchers' operation in the E seam using room and pillar mining methods. This expanded operation became known as the Hawk's Nest Mine.

The existing mine was subleased in 1932 by Mr. Clement Audin who continued to work the mine, purchasing the lease in 1938 and subsequently purchasing Champion Coal Company in 1942.

A second portal designated as the Hawk's Nest No. 2 Mine was developed in 1946 in the NW¼, SE¼, Section 11, T13S, R90W, in an area where roof conditions were better. The old portal and mine area, subsequently designated as the Hawk's Nest No. 1 Mine, were closed in 1947.

In 1953, Mr. Ellis Axelson opened a new mine, the Black Beauty Mine, from a portal at the E seam outcrop located in the NE¼, SE¼, Section 10, T13S, R90W. A second portal, the East Oliver portal and the associated Oliver Mine were subsequently developed approximately 1,000 feet to the west of the original portal. The Oliver Mine extracted coal from both the D and E coal seams.

Western Slope Carbon, Inc. was incorporated in 1970. The corporation purchased the Hawk's Nest No. 1 and No. 2 Mines from the Audin family and the Black Beauty Mine from Mr. Axelson. The Black Beauty Mine was then renamed Hawk's Nest No. 3. The Hawk's Nest No. 1 was closed in 1947 by the Audin family, and the Hawk's Nest No. 2 Mine was closed in 1970 due to insufficient capital. Western Slope Carbon, Inc. then renovated the Hawk's Nest No. 3 Mine. A bleeder portal was developed for ventilation.

In December 1974, Western Slope Carbon, Inc. was acquired as a wholly-owned subsidiary of Northwest Energy Company. The Hawk's Nest No. 2 portal was re-designated as the East portal, and all surface facilities were replaced and the underground workings were rehabilitated.

In the fall of 1980, a portion of the Hawk's Nest Mine was converted from conventional room and pillar mining to the first longwall operation in the North Fork of the Gunnison River valley. The Hawk's Nest No. 3 portal was re-designated as the West portal, and underwent significant surface and underground renovation.

From 1966 through 1970, the Hawk's Nest mining complex produced approximately 174,144 tons of coal from the E seam, or an average of approximately 43,536 tons per year. From the period 1970 through 1983, the Hawk's Nest No. 3 Mine produced 2,623,600 tons from the E seam, or approximately 201,815 tons per year. When the Hawk's Nest No. 2 Mine was reopened and operated from 1976 through 1980, approximately 1,321,017 tons were removed from the E seam, or an average of approximately 330,254 tons per year. The idled property was purchased in the late 1980s and was to be operated as the Blue Horizon Coal Company, but never came to be.

The Hawk's Nest portal areas were reclaimed during 1990 and 1991 by the Colorado Division of Minerals and Geology after bond forfeiture. The mine portals were sealed, all surface facilities were removed, and the areas were contoured and seeded.

King Mine

The King Mine was located in Sections 3, 10 and 11, T13S, R91W, and produced coal from 1903 to 1975. The mine initially utilized a pick and shovel method of operation. The early mine plant consisted of a stable, mules, blacksmith shop, and steam plant and pump. In later years, the coal was shot and loaded with mechanized loading machines. The coal was initially hauled from the portal with wagon teams. A tramway from the mine was completed in 1907. A four-track tipple was used to load the coal onto rail cars. The mine supplied coal to a mine mouth electric power generating station from 1922 until about 1949. The power plant supplied electricity to the surrounding area. The King Mine produced from the B seam. Previous operators of the property included Jack, Alex and Wallace Bowie (1903-1917), Juanita Coal and Coke Company (1917-1974), and Adolph Coors Company (1974-1995). The mine produced a variety of tonnage ranging from a low of 1,049 tons in 1906 to a high of 103,622 tons in 1920. In total, the mine produced 2,996,248 tons or an average of approximately 41,615 tons per year. In 1995, the Adolph Coors Company sold the property to Bowie Resources, and the Bowie No. 2 Mine was developed.

Orchard Valley Mine

The Orchard Valley Mine was opened in 1976 at the site of the old Converse Mine in the SW¼, NW¼, Section 24, T13S, R92W. The Orchard Valley Mine was owned and operated by Colorado Westmoreland Inc. The mine produced coal from the D seam from 1976 to1993. A total of 5,726,166 tons were mined from the Orchard Valley Mine, at an average of approximately 716,021 tons per year.

Colorado Westmoreland Inc. also built a modern train loadout facility adjacent to the North Fork of the Gunnison River in portions of Sections 31, 32 and 29, T13S, R91W. This facility included a truck dump station, coal silos, and a coal train loadout, along with a spur line from the main Denver and Rio Grande Railroad line.

In June 1986, the Orchard Valley Mine was closed after a mine fire. The mine re-opened through west portals in January 1987. The property, including the mining operation and the loadout were later sold to Cyprus Coal Company in 1994, who in turn sold to Bowie Resources, Ltd. in 1996. The Orchard Valley Mine was renamed the Bowie No. 1 Mine, and the associated coal loadout facilities near Paonia became known as the Bowie No. 1 Loadout.

Sanborn Creek Mine

In 1990, the Somerset Mining Company developed and opened the new Sanborn Creek Mine in the C seam. This mine utilizes the surface facilities at the location of the old Somerset Mine. The Sanborn Creek Mine has continued operations through a series of names including: Somerset Mining Company (1990-1995), Pacific Basin Resources (1995-1996), and Oxbow Mining, Inc. (1997-present). While ownership entities appear to have changed over the period from 1990 through present, Oxbow Carbon and Minerals, Inc. has remained in ownership since the start of the mine. Mine personnel and operations have generally remained stable.

New coal handling facilities have been constructed at the Sanborn Creek Mine, along with a new shop and office complex. A new batch rail loadout has also been added to this facility.

The Sanborn Creek Mine utilizes longwall mining techniques and mined 1.5 million tons of coal in 1998. The mine was planning for a production of 4.0 million tons in 1999, but was forced to shutdown in January of 1999 when elevated CO and CO_2 were detected in the mine ventilation exhaust as the result of a fire. The mine was sealed and the mine fire area flooded with water. After working with the Mine Safety and Health Administration on safety issues and precautions, Oxbow reopened the operation in June of 1999.

The new Elk Creek Mine, with its longwall system and related conveying capacity will have the potential to produce up to 6 million tons per year of coal.

Somerset Mine

In 1902, shortly after initial coal discoveries and development in the area, the Denver and Rio Grande Railroad was extended up the North Fork of the Gunnison River valley to Somerset.

With both the need for coal for railroad and access to other markets, the Utah Fuel Corporation constructed a company town at Somerset in 1903 and operated the Somerset Mine from portals at the C seam outcrop. In the 1920s, approximately 300 miners produced 1,200 tons of coal daily from the Somerset Mine. The Somerset Mine portals and associated surface facilities, located in the SW¼, SE¼, Section 8, T13S, R90W, occupied the area of the present Oxbow Mining, Inc. surface facilities.

The Somerset Mine was a major producer in the North Fork of the Gunnison River valley, operating continuously through the 1980s. The mine had a series of owners including Utah Fuel Corporation (1903 through 1935), Kaiser Steel Corporation (1935 through 1946), Minerals Development Corporation (1946 through 1958), U.S. Steel Mining Company (1958 through 1985), and Kaiser Coal Company (1986 through 1990).

Ongoing expansion of the Somerset Mine and associated surface facilities included development of surface facilities along Bear Creek in the 1960s and Hubbard Creek in the 1970s and 1980s. The Somerset Mine extracted coal from the B seam under Bear Creek and under Hubbard Creek. When the Somerset Mine was shutdown at the end of 1985, mining was occurring west of Hubbard Creek in the B seam. The C seam was mined until about 1980 when U.S. Steel Corporation dosed the entire Somerset operation.

There was extensive renovation and construction work at the Somerset Mine in the 1960s. This included the construction of a dump station and crusher installation in the early 1960s, followed by the construction of a coal storage silo and a new rail line in the late 1960s. Production from the Somerset Mine ceased in 1985, and the mine sat idle until 1990. At this time, the B and C seam portals were sealed.

In 1990, the Somerset Mining Company developed and opened the new Sanborn Creek Mine in the C seam. The existing surface facilities of the Somerset Mine were again utilized.

Terror Creek Loadout

A custom coal loadout, known as the Terror Creek Loadout, was constructed in 1982 by the Pacific Basin Coal and Carbon Company. The Terror Creek Loadout is located in Section 15,

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T13S, R91W. Originally, the Terror Creek Loadout received coal from the Bear No. 3 Mine. Presently, the loadout receives coal from the Sanborn Creek Mine. The Terror Creek Loadout is able to handle approximately 150,000 tons of coal per year. The facility is owned by Oxbow Carbon and Minerals, Inc. (88%) and the Bear Coal Company (12%). The facility is currently operated by Oxbow Carbon and Minerals, Inc.

West Elk Mine

The West Elk Mine portal facilities are located in the NW¼, Section 16, T13S, R90W. The mine was originally developed as the Mt. Gunnison No. 1 Mine in 1980 by ARCO under a subsidiary known as West Elk Coal Company, later (1993) changing its name to Mountain Coal Company. The mine was sold in 1998 to Arch Coal, Inc.'s western subsidiary, Arch Western Resources, LLC.

The original mine was a room and pillar operation in the F coal seam, but a longwall system of operation was added in the B coal seam in 1991. In 1998, Mountain Coal Company shipped 5,900,000 tons of coal from the West Elk Mine. Projections indicate that production could be up to 7.3 million tons in the year 2000 and 8.2 million tons in the year 2005.

Appendix H

Standard BLM Coal Lease Terms, Conditions and Stipulations

Form 3400-12
(January 1995)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FORM APPROVED
OMB NO. 1004-0073
Expires: June 30, 1997

Serial Number

COAL LEASE

PART I. LEASE RIGHTS GRANTED

This lease, entered into by and between the UNITED STATES OF AMERICA, hereinafter called lessor, through the Bureau of Land Management, and *(Name and Address)*

hereinafter called lessee, is effective *(date)* , for a period of 20 years and for so long thereafter as coal is produced in commercial quantities from the leased lands, subject to readjustment of lease terms at the end of the 20th lease year and each 10-year period thereafter.

Sec. 1. This lease is issued pursuant and subject to the terms and provisions of the:

☐ Mineral Lands Leasing Act of 1920, Act of February 25, 1920, as amended, 41 Stat. 437, 30 U.S.C. 181-287, hereinafter referred to as the Act;

☐ Mineral Leasing Act for Acquired Lands, Act of August 7, 1947, 61 Stat. 913, 30 U.S.C. 351-359;

and to the regulations and formal orders of the Secretary of the Interior which are now or hereafter in force, when not inconsistent with the express and specific provisions herein.

Sec. 2. Lessor, in consideration of any bonuses, rents, and royalties to be paid, and the conditions and covenants to be observed as herein set forth, hereby grants and leases to lessee the exclusive right and privilege to drill for, mine, extract, remove, or otherwise process and dispose of the coal deposits in, upon, or under the following described lands:

containing acres, more or less, together with the right to construct such works, buildings, plants, structures, equipment and appliance
and the right to use such on-lease rights-of-way which may be necessary and convenient in the exercise of the rights and privileges granted, subject t
the conditions herein provided.

PART II. TERMS AND CONDITIONS

Sec. 1. (a) RENTAL RATE - Lessee shall pay lessor rental annually and in advance for each acre or fraction thereof during the continuance of the lease at the rate of $ for each lease year.

(b) RENTAL CREDITS - Rental shall not be credited against either production or advance royalties for any year.

Sec. 2. (a) PRODUCTION ROYALTIES - The royalty shall be percent of the value of the coal as set forth in the regulations. Royalties are due to lessor the final day of the month succeeding the calendar month in which the royalty obligation accrues.

(b) ADVANCE ROYALTIES - Upon request by the lessee, the authorized officer may accept, for a total of not more than 10 years, the payment of advance royalties in lieu of continued operation, consistent with the regulations. The advance royalty shall be based on a percent of the value of a minimum number of tons determined in the manner established by the advance royalty regulations in effect at the time the lessee requests approval to pay advance royalties in lieu of continued operation.

Sec. 3. BONDS - Lessee shall maintain in the proper office a lease bond in the amount of $. The authorized officer may require an increase in this amount when additional coverage is determined appropriate.

Sec. 4. DILIGENCE - This lease is subject to the conditions of diligen
development and continued operation, except that these conditions ar
excused when operations under the lease are interrupted by strikes, th
elements, or casualties not attributable to the lessee. The lessor, in th
public interest, may suspend the condition of continued operation upo
payment of advance royalties in accordance with the regulations i
existence at the time of the suspension. Lessee's failure to produce coa
in commercial quantities at the end of 10 years shall terminate th
lease. Lessee shall submit an operation and reclamation plan pursuan
to Section 7 of the Act not later than 3 years after lease issuance.

The lessor reserves the power to assent to or order the suspension of th
terms and conditions of this lease in accordance with, inter ali
Section 39 of the Mineral Leasing Act, 30 U.S.C. 209.

Sec. 5. LOGICAL MINING UNIT (LMU) - Either upon approval by th
lessor of the lessee's application or at the direction of the lessor, thi
lease shall become an LMU or part of an LMU, subject to the provision
set forth in the regulations.

The stipulations established in an LMU approval in effect at the time
LMU approval will supersede the relevant inconsistent terms of th
lease so long as the lease remains committed to the LMU. If the LMU
which this lease is a part is dissolved, the lease shall then be subject
the lease terms which would have been applied if the lease had not be
included in an LMU.

APPENDIX 6

Sec. 6. DOCUMENTS, EVIDENCE AND INSPECTION - At such times and in such form as lessor may prescribe, lessee shall furnish detailed statements showing the amounts and quality of all products removed and sold from the lease, the proceeds therefrom, and the amount used for production purposes or unavoidably lost.

Lessee shall keep open at all reasonable times for the inspection of any duly authorized officer of lessor, the leased premises and all surface and underground improvements, works, machinery, ore stockpiles, equipment, and all books, accounts, maps, and records relative to operations, surveys, or investigations on or under the leased lands.

Lessee shall allow lessor access to and copying of documents reasonably necessary to verify lessee compliance with terms and conditions of the lease.

While this lease remains in effect, information obtained under this section shall be closed to inspection by the public in accordance with the Freedom of Information Act (5 U.S.C. 552).

Sec. 7. DAMAGES TO PROPERTY AND CONDUCT OF OPERATIONS - Lessee shall comply at its own expense with all reasonable orders of the Secretary, respecting diligent operations, prevention of waste, and protection of other resources.

Lessee shall not conduct exploration operations, other than casual use, without an approved exploration plan. All exploration plans prior to the commencement of mining operations within an approved mining permit area shall be submitted to the authorized officer.

Lessee shall carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health, or property, and prevention of waste, damage or degradation to any land, air, water, cultural, biological, visual, and other resources, including mineral deposits and formations of mineral deposits not leased hereunder, and to other land uses or users. Lessee shall take measures deemed necessary by lessor to accomplish the intent of this lease term. Such measures may include, but are not limited to, modification to proposed siting or design of facilities, timing of operations, and specification of interim and final reclamation procedures. Lessor reserves to itself the right to lease, sell, or otherwise dispose of the surface or other mineral deposits in the lands and the right to continue existing uses and to authorize future uses upon or in the leased lands, including issuing leases for mineral deposits not covered hereunder and approving easements or rights-of-way. Lessor shall condition such uses to prevent unnecessary or unreasonable interference with rights of lessee as may be consistent with concepts of multiple use and multiple mineral development.

Sec. 8. PROTECTION OF DIVERSE INTERESTS, AND EQUAL OPPORTUNITY - Lessee shall: pay when due all taxes legally assessed and levied under the laws of the State or the United States; accord all employees complete freedom of purchase; pay all wages at lease twice each month in lawful money of the United States; maintain a safe working environment in accordance with standard industry practices; restrict the workday to not more than 8 hours in any one day for underground workers, except in emergencies; and take measures necessary to protect the health and safety of the public. No person under the age of 16 years shall be employed in any mine below the surface. To the extent that laws of the State in which the lands are situated are more restrictive than the provisions in this paragraph, then the State laws apply.

Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and the rules, regulations, and relevant orders of the Secretary of Labor. Neither lessee nor lessee's subcontractors shall maintain segregated facilities.

Sec. 9. (a) TRANSFERS

☐ This lease may be transferred in whole or in part to any person, association or corporation qualified to hold such lease interest.

☐ This lease may be transferred in whole or in part to another public body or to a person who will mine the coal on behalf of, and for the use of, the public body or to a person who for the limited purpose of creating a security interest in favor of a lender agrees to be obligated to mine the coal on behalf of the public body.

☐ This lease may only be transferred in whole or in part to another small business qualified under 13 CFR 121.

Transfers of record title, working or royalty interest must be approved in accordance with the regulations.

(b) RELINQUISHMENT - The lessee may relinquish in writing at any time all rights under this lease or any portion thereof as provided in the regulations. Upon lessor's acceptance of the relinquishment, lessee shall be relieved of all future obligations under the lease or the relinquished portion thereof, whichever is applicable.

Sec. 10. DELIVERY OF PREMISES, REMOVAL OF MACHINERY, EQUIPMENT, ETC. - At such time as all portions of this lease are returned to lessor, lessee shall deliver up to lessor the land leased, underground timbering, and such other supports and structures necessary for the preservation of the mine workings on the leased premises or deposits and place all workings in condition for suspension or abandonment. Within 180 days thereof, lessee shall remove from the premises all other structures, machinery, equipment, tools, and materials that it elects to or as required by the authorized officer. Any such structures, machinery, equipment, tools, and materials remaining on the leased lands beyond 180 days, or approved extension thereof, shall become the property of the lessor, but lessee shall either remove any or all such property or shall continue to be liable for the cost of removal and disposal in the amount actually incurred by the lessor. If the surface is owned by third parties, lessor shall waive the requirement for removal, provided the third parties do not object to such waiver. Lessee shall, prior to the termination of bond liability or at any other time when required and in accordance with all applicable laws and regulations, reclaim all lands the surface of which has been disturbed, dispose of all debris or solid waste, repair the offsite and onsite damage caused by lessee's activity or activities incidental thereto, and reclaim access roads or trails.

Sec. 11. PROCEEDINGS IN CASE OF DEFAULT - If lessee fails to comply with applicable laws, existing regulations, or the terms, conditions and stipulations of this lease, and the noncompliance continues for 30 days after written notice thereof, this lease shall be subject to cancellation by the lessor only by judicial proceedings. This provision shall not be construed to prevent the exercise by lessor of any other legal and equitable remedy, including waiver of the default. Any such remedy or waiver shall not prevent later cancellation for the same default occurring at any other time.

Sec. 12. HEIRS AND SUCCESSORS-IN-INTEREST - Each obligation of this lease shall extend to and be binding upon, and every benefit hereof shall inure to the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 13. INDEMNIFICATION - Lessee shall indemnify and hold harmless the United States from any and all claims arising out of the lessee's activities and operations under this lease.

Sec. 14. SPECIAL STATUTES - This lease is subject to the Clean Water Act (33 U.S.C. 1252 et. seq.), the Clean Air Act (42 U.S.C. 4274 et. seq.), and to all other applicable laws pertaining to exploration activities, mining operations and reclamation, including the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et. seq.).

Sec. 15. SPECIAL STIPULATIONS -

BEST COPY AVAILABLE

Sec. 15. SPECIAL STIPULATIONS (Cont'd.) -

THE UNITED STATES OF AMERICA

Company or Lessee Name	By
(Signature of Lessee)	(Signing Officer)
(Title)	(Title)
(Date)	(Date)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

This form does not constitute an information collection as defined by 44 U.S.C. 3502 and therefore does not require OMB approval.

GPO 884-479

Appendix I

Forest Service Stipulations Iron Point Coal Lease Tract and Exploration License Area

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APPENDIX I
FOREST SERVICE STIPULATIONS
IRON POINT COAL LEASE TRACT

Serial No. C-61209

CONTROLLED SURFACE USE STIPULATION
GENERAL FOREST(LEASE TRACT)

Surface occupancy or use is subject to the following special operating constraints.

Underground mining operations will result in surface subsidence. The operator/lessee shall perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such data is adequate for the intended purposes. The study shall be adequate to locate, quantify, and demonstrate the inter-relationship of the geology, topography, surface hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison.

The operator/lessee shall establish a monitoring system to locate, measure and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data.

Measures will be taken to insure that the Dove Cave is protected from the negative effects of subsidence and that its structural integrity is maintained. (Section 34, T12S, R91W, 6th PM)

If subsidence adversely affects surface resources, or causes a documented water loss, the operator shall:

1. Restore stream channels and surface drainage or protect stream flow with earthwork or temporary culverting; or
2. Restore affected road; or
3. Revegetate as necessary to protect against erosion; or
4. Restore or replace surface structures or compensate the owner of those surface structures; or
5. Provide other mitigation.

On lands described below:

National Forest System Lands within the entire lease.

For the purpose of:

To insure the stability of surface resources and facilities during and after the coal mining operations.

Waivers, exceptions, or modifications (WEMs) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-CSU-GF 2/95

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(REVISED 2-28-95) Serial No. C-61209

NO SURFACE OCCUPANCY STIPULATION
WETLANDS/FLOODPLAINS/RIPARIAN AREAS (LEASE TRACT)

No surface occupancy or use is allowed on the lands defined as a Wetland, a Floodplain, or a Riparian area.

Wetlands, Floodplains and Riparian Areas are defined as:

Wetlands: A Federal Manual which defines jurisdictional wetlands was jointly developed by the U.S. Corp of Engineers, the Soil Conservation Service, the Environmental Protection Agency and the U.S. Fish and Wildlife Service. (January 1987) This definition is adopted. In general, wetlands are defined by the presence of: permanent or seasonal water; water loving vegetation; and soil characteristics influenced by saturated conditions. All three of these conditions must exist in order to qualify as a wetland. (Page III-54, Oil and Gas Leasing EIS)

Floodplains: This is a strip of relatively smooth land adjacent to a river channel, constructed by the present river in its existing regimen and covered with water when the river overflows its banks. It is built of alluvium carried by the river during floods and deposited in the sluggish water outside the influence of the swiftest current. A river has only one floodplain but may have one or more terraces representing abandoned floodplains. (Page III-50, Oil and Gas Leasing EIS)

Riparian Areas: Geographically delineated areas with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems. (FSM WO 2500-94-4 pg 17) They may be associated with lakes, reservoirs, estuaries, potholes, marshes, streams, bogs, wet meadows, and intermittent or permanent streams where free and unbound water is available. (Page VII-13, Oil and Gas Leasing EIS) the riparian ecosystems are "transitional areas" between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities, and are characterized by species and/or life forms that are different from those of the immediately surrounding non-riparian climax area. (Page III-52, Oil and Gas Leasing EIS)

The application of the definition for wetlands, floodplains, and riparian areas to ground conditions will determine whether the stipulation applies. When facilities and activities associated with coal mining must occur in these areas, impacts to these areas will be minimized and mitigated. Roads will cross streams at right angles and access across other areas subject to this stipulation will be held to a minimum. Streams will not be paralleled by roads through these areas other than to the extent necessary for crossings.

The width of adjacent upland areas which will fall under jurisdiction of this stipulation, will be dependent on slope steepness, and the kind, amount, and location of surface and vegetation disturbance. (The GMUG Amended Land and Resource management Plan, Page III-75 provides guidelines for these areas.)

Forest Development Road 842 (East Fork of Terror Creek Road) has been in existence for many years and portions of it traverses through riparian areas. The road

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is deemed necessary for continued public and coal operation access to the East Fork of Terror Creek area. Therefore, it is granted an exception.

For the purpose of:

The management of wetlands and floodplains are subject to Executive Orders (EO) 11990 and 11988, respectively. The purpose of the EOs are to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and floodplains and to avoid direct or indirect support of new construction in wetlands wherever there is a practical alternative.

Also, it is recognized that there is a direct relationship between impacts on such areas and effects on water quality and aquatic ecosystems. There is a high risk of irreversible and irretrievable impacts on the latter with operation and developments in wetlands, floodplains and riparian areas.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements.

Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Conditions under which a WEM could be granted:

If it can be shown through environmental analysis and the application of mitigation measures that the impacts to wetland, floodplain and riparian resources will be minimized and that no other alternative location for facilities and activities associated with coal mining is practical because of environmental effects and operational considerations (eg, economics, health and safety, etc.)

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-NSO-WFR 2/95

(REVISED 2-28-95) Serial No. C-61209

CONTROLLED SURFACE USE STIPULATION
MODERATE GEOLOGIC HAZARDS (LEASE TRACT)

Surface occupancy or use is subject to the following special operating constraints.

Special interdisciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas having moderate geologic hazards. (The interdisciplinary team could include: geotechnical engineer, soils engineer, road engineer, coal mining engineer and reclamation specialist.) Attributes constituting moderate geologic hazard include stabilized earthflows, stabilized mudflows, stabilized landslides; slopes adjacent to failed slopes or active earthflows, mudflows, or landslides and avalanche chutes; areas of rockfall; and flash flood areas.

On lands described below:

Portions of Section 33, T12S, R91W, 6th PM with moderate geologic hazards as generally delineated on a map prepared on 1-15-98 by Michael Ward. The map is for planning purposes only. The application of the definition of moderate geologic hazard to ground conditions will determine whether the stipulation applies. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which is classified as having moderate geologic hazards falls under jurisdiction of this stipulation.

For the purpose of:

To insure the stability of facilities required (such as roads, waterlines, water tanks, powerlines, ventilation shafts, ancillary buildings, drillpads, etc.) during the coal mining operations and to insure the stability of lands adjacent to these facilities.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-CSU-MGH 2/95

(REVISED 3-9-95) Serial No. C-61209

NO SURFACE OCCUPANCY STIPULATION
HIGH GEOLOGIC HAZARD (LEASE TRACT)

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description) except when a waiver, exception, or modification (WEM) to this stipulation is granted. See WEM clause below.

Portions of Section 33, and 34, T12S, R91W, 6th PM are characterized by high geologic hazards defined as active mudflows, active earthflows, active landslides and areas prone to avalanche. Presumed areas of No Surface Occupancy are generally delineated on a map prepared by Michael K. Ward on 1-15-98. The map is for planning purposes only. The application of the definition of high geologic hazard to ground conditions will determine whether the stipulation applies. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which is classified as high geologic hazard falls under jurisdiction of this stipulation.

For the purpose of:

Avoidance of areas with high geologic hazard to prevent further mass slope failure.

It may be necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a Forest Service discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Conditions under which a WEM may be granted include the following:

1. Use of the area for a short distance or a small area.
2. Mitigation and design can minimize impacts to soil and visual resources, for example, powerlines and waterlines required through these areas shall be constructed to minimize impacts.
3. No other alternative location for facilities and activities associated with coal mining is practical because of environmental effects and operational considerations (eg, economics, health and safety, etc.).

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-NSO-HGH 2/95

(REVISED 2-28-95) Serial No. C-61209

TIMING LIMITATION STIPULATION
BIG GAME WINTER RANGE (LEASE TRACT)

No surface use is allowed during the following time period(s). This stipulation does not apply to operation and maintenance of facilities associated with coal mining.

1. Exploration, drilling and development activity will not be allowed during the period from December 1 to April 30. In the event of an emergency, surface use (including drilling) may be allowed with authorization from the Forest Service.

2. New roads on public lands will be closed yearlong to the public.

On the lands described below:

All or portions of Section 33 and 34, T12S, R91W, 6th PM with winter ranges for big game (elk) as generally delineated on a map, prepared on 1-15-98 by Michael K. Ward. The map is for planning purposes only. The existence of big game winter range on the ground will determine whether the stipulation applies. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which is classified as big game winter range for elk falls under jurisdiction of this stipulation.

For the purpose of (reasons):

Preventing unnecessary stress on the wintering wildlife herds and causing an increase in mortality resulting from disturbances and habitat losses. These areas are critical for elk during winter. They serve as key concentration areas which support and sustain this species and are extremely important for animal survival.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1950 and 2820.)

Coal-TL-BGWR 2/95

(REVISED 3-9-95) Serial No. C-61209

NO SURFACE OCCUPANCY STIPULATION
SLOPES > 60% (LEASE TRACT)

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description) except when a waiver, exception, or modification (WEM) to this stipulation is granted. See WEM clause below.

> Portions of Section 33 and 34, T12S, R91W, 6th PM with slopes greater than 60%. Presumed areas of No Surface Occupancy are generally delineated on a map prepared by Michael K. Ward on 1/15/98. The map is for planning purposes only. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which has slopes greater than 60% fall under jurisdiction of this stipulation.

For the purpose of (reasons):

> Protection of areas with slopes greater than 60% prevent impacts to soil resources through erosion, mass failure, loss of productivity, etc.
>
> It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a Forest Service discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Conditions under which a WEM may be granted include the following:

1. Use of the surface for a short distance or a small area.
2. Mitigation and design can minimize impacts to soil and visual resources; for example, powerlines and waterlines required on slopes greater than 60% shall be constructed so as to minimize impacts.
3. No other alternative location for facilities and activities associated with coal mining is practical because of environmental effects and operational considerations (eg, economics, health and safety, etc.).

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1950 and 2820.)

Coal-NSO->60% 2/95

431

(REVISED 2-28-95) Serial No. C-61209

CONTROLLED SURFACE USE STIPULATION
SLOPES 40-60% (LEASE TRACT)

Surface occupancy or use is subject to the following special operating constraints.

Special inter-disciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas with slopes ranging from 40-60%. (The interdisciplinary team could include engineering, soil scientist, hydrologist, landscape architect, reclamation specialist and coal mining engineer.)

Mitigation may include, but is not limited to, use of erosion control cloths, mats, geoweb soil support materials, lifting and saving local native vegetation in chunks of sod to be later placed over disturbed areas, reseeding disturbed banks with stabilizing seed mix, use of chemical stabilizers, tackifiers and blankets and careful design of surface water flow.

On the lands described below:

Portions of Section 33 and 34, T12S, R91W, 6th PM with slopes 40-60% as generally delineated on a map prepared on 1-15-98 by Michael Ward. The map is for planning purposes only. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which has slopes ranging from 40-60% falls under jurisdiction of this stipulation.

For the purpose of:

Minimizing potential for soil loss, mass land movement, revegetation failure and unacceptable visual impairment.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1950 and 2820.)

Coal-CSU-40-60-2/95

(REVISED 2-28-95)

Serial No. C-61209

CONTROLLED SURFACE USE STIPULATION BIG GAME WINTER RANGE (LEASE TRACT)

Surface occupancy or use is subject to the following special operating constraints.

Operation and maintenance of facilities associated with coal mining such as roads, waterlines, water tanks, powerlines, ventilation shafts, ancillary buildings, and including monitoring will be scheduled to minimize adverse effects on big game (elk) from December 1 to April 30. Unscheduled use will be allowed in emergency situations with notice and coordination with the Forest Service.

Limit road use to periods when animals are not present on the winter range. Restrict road use to personnel associated with operation and maintenance of coal mining facilities. Recontour and revegetate to prior existing conditions (to extent possible) new roads when work is complete.

On lands described below:

Portions of Section 33 and 34, T12S, R91W, 6th PM with winter range for big game (elk) as generally delineated on a map prepared on 1-15-98 by Michael K. Ward. The map is for planning purposes only. The existence of big game winter range on the ground will determine whether the stipulation applies. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which is classified as big game winter range for elk falls under jurisdiction of this stipulation.

For the purpose of:

Protecting big game winter range for elk. These ranges are extremely important for animal survival during winter. Disturbances and habitat losses may place unnecessary stress on the wintering wildlife herds and cause an increase in herd mortality.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-CSU-WR 2/95

Serial No. C-61209

TIMING LIMITATION STIPULATION
FALL-WINTER SHUT-DOWN (LEASE TRACT)

No surface use is allowed during the following time period(s).

1. Exploration, drilling and development activity will not be allowed during the period from: October 1 through May 15, or whenever conditions in the spring are sufficiently dry to allow operations without causing surface damage. Operations between October 1 and the Friday preceding regular big game hunting season, usually around October 10, may be allowed during dry weather upon written authorization of the authorized officer.

2. New roads on public lands will be closed yearlong to the public.

On the lands described below:

Portions of Section 33 and 34, T12S, R91W, 6th PM as generally delineated on a map, prepared on 1-15-98 by Michael K. Ward. All National Forest System Land within the leasehold falls under jurisdiction of this stipulation.

For the purpose of (reasons):

1. Protecting the soil and water resource, particularly with regard to roads and other surface disturbances.

1. Provide for safety of the general public and the operator.

2. Reduce user conflict during regular big game hunting seasons.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1950 and 2820.)

Coal-TL-BGWR 2/98
Serial No. C-61209

LEASE NOTICE
INTERIM ROADS POLICY (LEASE TRACT)

Lands contained within this lease are subject to the Forest Service interim Rule, "Administration of the Forest service Development Transportation System: Temporary Suspension of Road Construction and Reconstruction in Unroaded Areas"; Federal Register/Vol. 64. No. 29/Friday, February 12, 1999, pages 7290 through 7305. These lands will also be subject to the final road management policy which will be set within 18 months.

No road construction will be allowed within the unroaded area until the Forest Service adopts its revised road management policy or 18 months from the effective date of this final interim rule, whichever is sooner.

Serial No. COC-61945

NO SURFACE OCCUPANCY STIPULATION WETLANDS/FLOODPLAINS/RIPARIAN AREAS (EXPLORATION LICENSE APPLICATION)

No surface occupancy or use is allowed on the lands defined as a Wetland, a Floodplain, or a Riparian area. These areas are generally shown on USGS quadrangle maps.

> Wetlands, Floodplains, and Riparian Areas of any defined drainage or location containing these specific ecosystem types come under jurisdiction of this stipulation. Drill pads, staging areas and storage sites will not be allowed in these areas. When road locations must occur in these areas, streams will be crossed at right angles and access across other areas will be held to a minimum. Streams will not be paralleled by roads through these areas.
>
> Location of these areas which is more specific than can be identified on USGS topographical maps will come at the APD stage based on on-the-ground observations.

For the purpose of:

> The management of wetlands and floodplains are subject to Executive Orders (EO) 11990 and 11988, respectively. The purpose of the EO's are to avoid, to the extent possible, the long and short term adverse impacts associated with the destruction or modification of wetlands and floodplains and to avoid direct or indirect support of new construction in wetlands wherever there is a practical alternative.
>
> Also, it is recognized that there is a direct relationship between impacts on such areas and effects on water quality and aquatic ecosystems. There is a high risk of irreversible and irretrievable impacts on the latter with operation and developments in wetlands, floodplains and riparian areas.
>
> Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

NSO-WFR 4/97

Serial No. COC-61945

TIMING LIMITATION STIPULATION
SPECIAL WILDLIFE HABITATS
(EXPLORATION LICENSE APPLICATION)

No surface use is allowed during the following time period(s). This stipulation does not apply to operation and maintenance of production facilities.

Elk calving and mule deer fawning areas:	April 15 to July 1
Elk and mule deer migration routes:	March 1 to May 30 November 1 to December 31
Elk and mule deer staging areas:	October 15 to December 31
Sage Grouse Leks and nesting areas: (Within a 2 ½ mile radius of the leks)	March 1 to June 1

On the lands described below:

a. Elk calving and mule deer fawning areas.
b. Elk and mule deer migration routes and staging areas.
c. Sage grouse leks and nesting areas.

All lands categorized as listed in a, b, and c above fall within jurisdiction of this stipulation.

For the purpose of (reasons):

Preventing human disturbance which would produce increased stress, leading to poor physical condition, winter mortality and/or reduced reproduction. These areas have been identified through a coordinated effort with the Colorado Division of Wildlife. Disturbance during the reproductive season may reduce her productivity. For nesting species, surface disturbance and associated human activity could disrupt breeding and/or cause nest abandonment. Disruption of migration routes or staging areas could result in direct mortality to big game species by disrupting annual normal staging and migration patterns to winter ranges. Animals could be dispersed or delayed in traveling to their winter ranges, causing direct mortality during normal fall/early winter snows.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

TL-SWH 294

Serial No. COC-61945

NO SURFACE OCCUPANCY STIPULATION
HIGH GEOLOGIC HAZARD
(EXPLORATION LICENSE APPLICATION)

No surface occupancy or use is allowed on the lands described below.

> Areas of high geologic hazard have been mapped from aerial photographs and are characterized by active mudflows, active earthflows, active landslides and areas prone to avalanche. All areas within the lease with high geologic hazard are under jurisdiction of this stipulation.

For the purpose of:

> Avoidance of areas with high geologic hazard to prevent mass slope failure.
>
> Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

NSO-HGH 4/97

Serial No. COC-61945

CONTROLLED SURFACE USE STIPULATION
SLOPES 40-60%
(EXPLORATION LICENSE APPLICATION)

Surface occupancy or use is subject to the following special operating constraints.

Special inter-disciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas with slopes ranging from 40-60%. (Inter-disciplinary team disciplines could include engineering, soil scientist, hydrologist, landscape architect, reclamation specialist and oil and gas specialist.)

Mitigation may include use of erosion control cloths, mats, geoweb soil support materials, lifting and saving local native vegetation in chunks of sod to be later placed over disturbed areas, reseeding disturbed banks with stabilizing seed mix, use of chemical stabilizers, tackifiers and blankets and careful design of surface water flow.

For the purpose of:

Minimizing potential for soil loss, mass land movement, revegetation failure and unacceptable visual impairment.

Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1650 and 2820.)

CSU 40-60 4/97

Serial No. COC-61945

NO SURFACE OCCUPANCY STIPULATION
SLOPES >60%
(EXPLORATION LICENSE APPLICATION)

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description). All areas within the leasehold with 60% slopes or greater fall under jurisdiction of this stipulation.

For the purpose of:

> Protection of areas with slopes greater than 60% to prevent impacts to soil resources through erosion, mass failure, loss of productivity, etc.
>
> Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 or FS Manual 1950 and 2820.)

NSO-60%+ 294

Serial No. COC-61945

CONTROLLED SURFACE USE STIPULATION
MODERATE GEOLOGIC HAZARDS
(EXPLORATION LICENSE APPLICATION)

Surface occupancy or use is subject to the following special operating constraints.

> Special interdisciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas having moderate geologic hazards. (Interdisciplinary team disciplines could include: geotechnical engineer, soils engineer, roads engineer, oil and gas specialist and reclamation specialist.) Attributes constituting moderate geologic hazard include stabilized earthflows, stabilized mudflows or landslides and avalanche chutes; areas of rockfall; flash flood zones; and areas with potential mining related problems (i.e., subsidence, acid drainage). Any area within the leasehold which is identified as having moderate geologic hazard falls under jurisdiction of this stipulation.

For the purpose of:

> To insure the stability of facilities required (roads, pipelines, drillpads, etc.) and to insure the stability of lands adjacent to these facilities.
>
> Waivers, exceptions, or modifications (WEM's) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3101 ro FS Manual 1650 and 2820.)

SU-MGH 294

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STIPULATION FOR LANDS OF THE NATIONAL FOREST SYSTEM UNDER JURISDICTION OF THE DEPARTMENT OF AGRICULTURE

The license/permittee/lessee must comply with all the rules and regulations of the Secretary of the Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System (NFS) when not inconsistent with the rights granted by the Secretary of the Interior in the license/permit/lease. The Secretary of Agriculture's rules and regulations must be complied with for (1) all use and occupancy of the NFS prior to approval of a permit/operation plan by the Secretary of the Interior, (2) use of all existing improvements, such as Forest Development Roads, within and outside the area licensed, permitted or leased by the Secretary of Interior, and (3) use and occupancy of the NFS not authorized by a permit/operating plan approved by the Secretary of the Interior.

All matters related to this stipulation are to be addressed to:

Forest Supervisor
Grand Mesa, Uncompahgre, and Gunnison National Forests
2250 Highway 50
Delta, CO 81416
Telephone: 970-874-6600

Appendix J

Forest Service Stipulations Elk Creek Coal Lease Tract

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APPENDIX J
FOREST SERVICE STIPULATIONS
ELK CREEK COAL LEASE TRACT

(REVISED 2-28-95) Serial No. C-61357

CONTROLLED SURFACE USE STIPULATION
MODERATE GEOLOGIC HAZARDS

Surface occupancy or use is subject to the following special operating constraints.

Special interdisciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas having moderate geologic hazards. (The interdisciplinary team could include: geotechnical engineer, soils engineer, roads engineer, coal mining engineer and reclamation specialist.) Attributes constituting moderate geologic hazard include stabilized earthflows, stabilized mudflows, stabilized landslides; slopes adjacent to failed slopes or active earthflows, mudflows, or landslides and avalanche chutes; areas of rockfall; and flash flood areas.

On lands described below:

Portions of Section 32, T12S, R90W, 6th PM with moderate geologic hazards as generally delineated on a map prepared on 10-30-98 by Michael Ward. The map is for planning purposes only. The application of the definition of moderate geologic hazard to ground conditions will determine whether the stipulation applies. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which is classified as having moderate geologic hazards falls under jurisdiction of this stipulation.

For the purpose of:

To insure the stability of facilities required (such as roads, waterlines, water tanks, powerlines, ventilation shafts, ancillary buildings, drillpads, etc.) during the coal mining operations and to insure the stability of lands adjacent to these facilities.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEM's to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-CSU-MGH 2/95

445

(REVISED 2-28-95)

Serial No. C-61357

CONTROLLED SURFACE USE STIPULATION
SLOPES 40-60%

Surface occupancy or use is subject to the following special operating constraints.

Special inter-disciplinary team analysis and mitigation plans detailing construction and mitigation techniques will be required on areas with slopes ranging from 40-60%. (The interdisciplinary team could include engineering, soil scientist, hydrologist, landscape architect, reclamation specialist and coal mining engineer.)

Mitigation may include, but is not limited to, use of erosion control cloths, mats, geoweb soil support materials, lifting and saving local native vegetation in chunks of sod to be later placed over disturbed areas, reseeding disturbed banks with stabilizing seed mix, use of chemical stabilizers, tackifiers and blankets and careful design of surface water flow.

On lands described below:

Portions of Section 32, T12S, R90W, and Section 35, T12S, R91W, 6th PM with slopes 40-60%. All National Forest System Land within the leasehold which has slopes ranging from 40-60% falls under jurisdiction of this stipulation.

For the purpose of:

Minimizing potential for soil loss, mass land movement, revegetation failure and unacceptable visual impairment.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-CSU 40-60 2/95

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(REVISED 2-28-95) Serial No. C-61357

CONTROLLED SURFACE USE STIPULATION
BIG GAME WINTER RANGE

Surface occupancy or use is subject to the following special operating constraints.

Operation and maintenance of facilities associated with coal mining such as roads, waterlines, water tanks, powerlines, ventilation shafts, ancillary buildings, and including monitoring will be scheduled to minimize adverse effects on big game (elk) from December 1 to April 30. Unscheduled use will be allowed in emergency situations with notice and coordination with the Forest Service.

Limit road use to periods when animals are not present on the winter range. Restrict road use to personnel associated with operation and maintenance of coal mining facilities. Recontour and revegetate to prior existing conditions (to extent possible) new roads when work is complete.

On lands described below:

Portions of Section 32, T12S, R90W and Section 35, T12S, R91W, 6th PM with winter range for big game (elk) as generally delineated on a map prepared on 10-30-98 by Michael K. Ward. The map is for planning purposes only. The existence of big game winter range on the ground will determine whether the stipulation applies. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which is classified as big game winter range for elk falls under jurisdiction of this stipulation.

For the purpose of:

Protecting big game winter range for elk. These ranges are extremely important for animal survival during winter. Disturbances and habitat losses may place unnecessary stress on the wintering wildlife herds and cause an increase in herd mortality.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-CSU-WR 2/95

Serial No. C-61357

CONTROLLED SURFACE USE STIPULATION
GENERAL FOREST

Surface occupancy or use is subject to the following special operating constraints.

Underground mining operations will result in surface subsidence. The operator/lessee shall perform a study to secure adequate baseline data to quantify the existing surface resources on and adjacent to the lease area. Existing data may be used if such data is adequate for the intended purposes. The study shall be adequate to locate, quantify, and demonstrate the inter-relationship of the geology, topography, surface hydrology, vegetation and wildlife. Baseline data will be established so that future programs of observation can be incorporated at regular intervals for comparison.

The operator/lessee shall establish a monitoring system to locate, measure and quantify the progressive and final effects of underground mining activities on the topographic surface, underground and surface hydrology and vegetation. The monitoring system shall utilize techniques which will provide a continuing record of change over time and an analytical method for location and measurement of a number of points over the lease area. The monitoring shall incorporate and be an extension of the baseline data.

If subsidence adversely affects surface resources, or causes a documented water loss, the operator shall:

1. Restore stream channels and surface drainage or protect stream flow with earhtwork or temporary culverting; or
2. Restore affected roads; or
3. Revegetate as necessary to protect against erosion; or
4. Restore or replace surface structures or compensate the owner of those surface structures; or
5. Provide other mitigation.

On lands described below:

National Forest System Lands within the entire lease.

For the purpose of:

To insure the stability of surface resources and facilitate during and after the coal mining operations.

Waivers, exceptions, or modifications (WEMs) to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a

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WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1650 and 2820.)

Coal-CSU-GF 2/95

(REVISED 3-9-95) Serial No. C-61357

CONTROLLED SURFACE USE STIPULATION
HIGH GEOLOGIC HAZARD

No surface occupancy or use is allowed on the lands described below (legal subdivision or other description) except when a waiver, exception, or modification (WEM) to this stipulation is granted. See WEM clause below.

Portions of Section 32, T12S, R90W, and Section 35, T12S, R91W, 6th PM are characterized by high geologic hazards defined as active mudflows, active earthflows, active landslides and areas prone to avalanche. Presumed areas of No Surface Occupancy are generally delineated on a map prepared by Michael K. Ward on 10-30-98. The map is for planning purposes only. The application of the definition of high geologic hazard to ground conditions will determine whether the stipulation applies. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which is classified as high geologic hazard falls under jurisdiction of this stipulation.

For the purpose of:

Avoidance of areas with high geologic hazard to prevent further mass slope failure.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a Forest Service discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Conditions under which a WEM may be granted include the following:

1. Use of the area for a short distance or a small area.
2. Mitigation and design can minimize impacts to soil and visual resources, for example, powerlines and waterlines required through these areas shall be constructed to minimize impacts.
3. No other alternative location for facilities and activities associated with coal mining is practical because of environmental effects and operational considerations (eg, economics, health and safety, etc.).

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1950 and 2820.)

Coal-NSO-HGH 2/95

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(REVISED 2-28-95) Serial No. C-61357

TIMING LIMITATION STIPULATION
BIG GAME WINTER RANGE

No surface use is allowed during the following time period(s). This stipulation does not apply to operation and maintenance of facilities associated with coal mining.

1. Exploration, drilling and development activity will not be allowed during the period from December 1 to April 30. In the event of an emergency, surface use (including drilling) may be allowed with authorization from the Forest Service.

2. New roads on public lands will be closed yearlong to the public.

On the lands described below:

Portions of Section 32, T12S, R90W, and Section 35, T12S, R91W, 6th PM with winter ranges for big game (elk) as generally delineated on a map prepared on 10-30-98 by Michael K. Ward. The map is for planning purposes only. The existence of big game winter range on the ground will determine whether the stipulation applies. In the event of any conflict between written clauses of this stipulation and the map, the stipulation clauses shall control. All National Forest System Land within the leasehold which is classified as big game winter range for elk falls under jurisdiction of this stipulation.

For the purpose of (reasons):

Prevent unnecessary stress on the wintering wildlife herds and causing an increase in mortality resulting from disturbances and habitat losses. These areas are critical for elk during winter. They serve as key concentration areas which support and sustain this species and are extremely important for animal survival.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1950 and 2820.)

Coal-TL-BGWR 2/95

Serial No. C-61357

TIMING LIMITATION STIPULATION
FALL-WINTER SHUT-DOWN

No surface use is allowed during the following time period(s).

1. Exploration, drilling and development activity will not be allowed during the period from: October 1 through May 15, or whenever conditions in the spring are sufficiently dry to allow operations without causing surface damage. Operations between October 1 and the Friday preceding regular big game hunting season, usually around October 10, may be allowed during dry weather upon written authorization of the authorized officer.

2. New roads on public lands will be closed yearlong to the public.

On the lands described below:

All of the lease on National Forest System Lands within Section 32, T12S, R90W, and Section 35, T12S, R91W, 6th PM.

For the purpose of (reasons):

1. Protecting the soil and water resource, particularly with regard to roads and other surface disturbance.

2. Provide for safety of the general public and the operator.

3. Reduce user conflict during regular big game hunting seasons.

It may become necessary for a waiver, exception or modification (WEM) to this stipulation for the operator/lessee to use the surface in the area covered by this stipulation to allow for the recovery of the coal reserve. WEMs to this stipulation will be considered only at the time operations are proposed, and will be subject to the Forest Land and Resource Management Plan in effect at the time of consideration, and will be subject to applicable regulatory and environmental compliance requirements. Granting of a WEM is a discretionary action which the operator should not routinely expect. The Forest Service reserves the right to impose other stipulations in the same area of this leasehold if a WEM is granted.

Any changes to this stipulation will be made in accordance with the land use plan and/or the regulatory provisions for such changes. (For guidance on the use of this stipulation, see BLM Manual 1624 and 3400 or FS Manual 1950 and 2820.)

Coal-TL-BG-S&W-10/98

STIPULATION FOR LANDS OF THE NATIONAL FOREST SYSTEM UNDER JURISDICTION OF THE DEPARTMENT OF AGRICULTURE

The licensee/permittee/lessee must comply with all the rules and regulations of the Secretary of the Agriculture set forth at Title 36, Chapter II, of the Code of Federal Regulations governing the use and management of the National Forest System (NFS) when not inconsistent with the rights granted by the Secretary of the Interior in the license/permit/lease. The Secretary of Agriculture's rules and regulations must be complied with for (1) all use and occupancy of the NFS prior to approval of a permit/operation plan by the Secretary of the interior, (2) use of all existing improvements, such as Forest Development Roads, within and outside the area licensed, permitted or leased by the Secretary of Interior, and (3) use and occupancy of the NFS not authorized by a permit/operating plan approved by the Secretary of the Interior.

All matters related to this stipulation are to be addressed to:

Forest Supervisor
Grand Mesa, Uncompahgre, and Gunnison National Forests
2250 Highway 50
Delta, CO 81416
Telephone: 970-874-6600

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Appendix K

Subsidence Evaluation

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APPENDIX K
SUBSIDENCE EVALUATION

NOTE: There are four figures referenced in this appendix:

- K-1, Typical Subsidence Profile for Longwall
- K-2, Typical Longwall Subsidence Cross-Section
- K-3, Maximum Vertical Displacement for Longwall
- K-4, Tilt and Strain

These figures are included in the attached EIS "Figure Volume."

1.0 INTRODUCTION

Subsidence amounts and processes observed by the author and others in the Somerset-Paonia Area are described and analyzed for planned longwall mining of coal on the north side of the North Fork of the Gunnison River in Delta and Gunnison Counties, Colorado. This report is intended to serve as a technical reference document for the Elk Creek and Iron Point Coal Lease Tracts (see *Figure 1, General Location Map*), of the North Fork Coal Environmental Impact Statement (EIS).

2.0 DEFINITION OF TERMS AND SYMBOLS

Terms used to evaluate and analyze subsidence processes and amounts are described below.

Longwall Mining: See *Appendix F, Overview of Underground Coal Mining.*

Mining Panel: A rectangular mining area where mine openings are developed and coal is extracted. In longwall mining panels, development entries, or gate roads, are driven at either side of the panel boundaries and the intervening coal is extracted with a longwall cutting machine.

Head Gate: The gate roads (development entries) driven on the side of the mining panel adjacent to unmined coal, and on the side of the panel that is in the direction of further panel development.

Tail Gate: Gate roads driven on the opposite side of the mining panel from the head gate entries.

Mining Length and Width: The length and width of the longwall panel where coal is being extracted.

Vertical Displacement: The vertical downward movement of the overburden and ground surface caused by extracting the coal.

Maximum Vertical Displacement (Maximum Subsidence): The maximum vertical downward movement of the overburden and ground surface caused by extracting the coal.

Tilt and Maximum Tilt: The change in vertical displacement between two points at the ground surface divided by the horizontal distance between these points (differential vertical displacement); maximum tilt is the maximum projected for this area of the subsidence trough.

Maximum Horizontal Strain: The amount of horizontal change in length between two points of measurement divided by the horizontal distance between these two points (unit change in length); tensile strain is lengthening between these two points (unit elongation), compressive strain is shortening between these two points (unit shortening).

Subsidence Trough: A trough-like depression (downwarped area) that occurs above the panel where coal is being extracted; the trough is caused by differential vertical displacement of the ground surface.

Coal Extraction Thickness (t): The thickness of coal being mined; this value may be less than the actual seam thickness, because some coal of low quality may not be mined, some coal may be left in the roof ("top coal") for roof stability, or the seam may be too thick to be mined completely.

Overburden Depth (d): The vertical distance between the top of the coal seam being mined and the ground surface above it.

Critical Mining Width: The width of a mining panel necessary to cause maximum subsidence at a point on the ground surface. The length of the mining panel must also be equal to, or exceed this critical width. Critical width varies from 1.0 to 1.4 times the mining depth (overburden thickness).

Critical Mining Length: The length of the mining panel (length of coal area extracted) necessary to cause maximum vertical displacement (1.0 to 1.4 times the overburden depth).

Supercritical Mining Length and Width: A mining panel with a length and width that is greater than critical mining width.

Super Panel: Two or more mining panels that behave like one large panel; the overlying subsidence profile looks essentially like one large, single panel.

Draw (Limit) Angle (ϕ): The angle (from a vertical reference) of a straight line projected from the edge of the mining panel to the limit of subsidence at the surface above the edge of panel.

Break Angle ( ): The angle (from a vertical reference) of a straight line projected from the edge of the mining panel to the point of maximum lengthening (maximum horizontal strain) at the surface above the edge of the panel.

Bedrock: Rock that was originally formed under natural conditions, in contrast to unconsolidated material (colluvium, alluvium, and soil) derived bedrock.

Cleat: A system of planar fractures, or partings, in coal; there commonly are two cleat sets that are nearly perpendicular to each other.

Lineament: A linear topographic feature, which can be observed on-site and on aerial photographs, that often indicates a fault or an extensive fracture or fracture system.

Joint: A fracture surface or parting in rock, usually planar, without displacement, which often occurs periodically to form a joint set.

Fault: A fracture surface, parting, or series of partings in rock, often more extensive than joints, where rock on either side of the surface, or surfaces, is displaced (offset).

Bulking Factor: The volumetric increase of caved rock fragments relative to their volume prior to caving (in-place volume).

Coal Bump: The sudden release of strain energy that produces an explosion-like sound and shock waves in locations where stress (pressure) on the coal exceeds its strength.

Rock Burst: The sudden release of strain energy that produces an explosion-like sound and shock waves in locations where stress on the rock exceeds its strength.

3.0 GENERAL MINING INFORMATION

Longwall mining is planned for both the Elk Creek and Iron Point Coal Lease Tracts.

3.1 Elk Creek Tract

3.1.1 Panel Design

Panels in the Elk Creek Coal Lease Tract are projected to be arranged in groups of three or four, oriented in a north-south direction. A barrier pillar about 300ft wide is planned to be left between each panel group. All panels will be oriented in the north-south direction. Each of the longwall panels is projected to be a maximum of 800 ft wide, and range from 7,300 ft to 13,500 ft in length. Overburden depth (depth of cover), relative to the D-Seam, ranges from about 500 ft, in the southern part of the Tract, to 2,500 ft in the northern part. Coal extraction thickness reportedly will range from 9 to 12 ft; 12 ft is used herein as a conservative maximum thickness in the subsidence analysis.

3.1.2 Pillar Configuration and Design

Two yield pillars are currently expected to be developed in an offset pattern—on 70- by 120-ft centers at the head gate entry and 50- by 120-ft centers on the tail gate entry. Cross cut centers of each row of gate road pillars will be offset 60 ft from the adjacent row.

3.2 Iron Point Tract

3.2.1 Panel Design

D-seam panels are projected in about an east-west direction in a single group. Each panel is projected to have a maximum width of about 900 ft (including the yield pillars on the tail gate entries). The panels will range in length from about 6,500 to 7,000 ft. In the B-seam, which is stratigraphically below the D-seam, panels will have to be designed around the historic (now abandoned) King Mine. Panels will range in width from 700 to 900 feet, and in length from 2,500 to 7,000 feet. Panel orientation will also vary, trending from an east-west direction to a north-south direction. Overburden depth, relative to the D-seam, will range from about 500 ft to 2500 ft. Coal extraction thickness is planned to be 10 ft.

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3.2.2 Pillar Configuration and Design

One row of yield pillars and one row of stiff pillars is planned for the head gate and tail gate entries. The centerline dimension of the stiff pillars are currently planned to be 113 ft by 200 ft; the centerline dimension of the yield pillars 53 ft by 100 ft. Every other cross cut of the yield pillars will line up with the stiff pillar cross cuts.

3.3 Previous Mining

The B- and C-coal seams have been locally mined by the room-and-pillar method in the southern part of the Elk Creek Coal Lease Tract. See *Figure 3, Historic Coal Mines and Federal Coal Lease Locations*, in the attached EIS "Figure Volume." Prior B-seam mine workings are also located in the southern part of the Iron Point Coal Lease Tract. In both Tracts, the D-seam is separated stratigraphically from the C-seam by 150 to 200 ft of sandstone, siltstone, and shale; the D-seam is separated stratigraphically from the B-seam by 225 to 300 ft of similar rocks (Dunrud, 1989).

3.3.1 Mining in Disturbed Ground

The author measured subsidence of as much as 50% of the mining thickness (0.5 t) above room-and-pillar extraction panels in the Somerset mine (Dunrud, 1998, p. 92-93). However, the panels were bounded by barrier pillars 50 to 75 ft wide, which only yielded on the order of 30 to 40% of the mining thickness where the overburden depth was 500 to 1,000 ft. Any subsidence created by this past mining (on the order of 30% to 50% of the mining thickness) is likely complete by now, since this mining occurred many years (or even decades) ago.

3.3.2 Subsidence Amounts in Disturbed Versus Undisturbed Ground

Average maximum vertical displacement (S) for undisturbed ground, according to the National Coal Board (NCB, 1975, p.10) is about 90% of the amount measured in disturbed ground (i.e. 0.9 x 0.9=0.8t). See *Figure K-3, Maximum Vertical Displacement for Longwall*. Maximum subsidence (S), therefore, is projected to be about 90% of the amount of subsidence in undisturbed ground relative to disturbed ground. Therefore, average maximum subsidence due to D-seam mining in undisturbed ground, is projected to be 0.6 of the coal extraction thickness (0.6t), whereas it is projected to be 0.7t when the D-seam is mined above existing mine workings in the B- and C-seams.

3.3.3 D-Seam Mining Stresses and Deformations

Mining in the D-seam may cause some additional deformation of unmined pillars in the lower seams, which could then cause some additional impact at the mine level when the D-seam is mined. However, any increase in subsidence will likely only be on the order of 10%, as indicated by the NCB (1975, p. 10).

3.4 Multiple Seam Mining

Subsidence is projected to be additive, where mining occurs in more than one coal seam in the lease tracts. This includes maximum vertical displacement (subsidence) (S), tilt (M), and horizontal strain (E, -E).

- This projection is conservative, because it basically assumes that both seams are mined very quickly, if not instantaneously. In reality, the strain effects of mining one seam will be reduced to by a varying extent (depending on the length of time until the next seam is mined) by filling, healing, and sealing of any cracks present by the natural forces of erosion and sedimentation.

- In the event that the B- and D-seam seams are sequentially mined in the Elk Creek and/or Iron Point Coal Lease Tracts, subsidence would occur in sequence with coal extraction.

- For example, in undisturbed ground in the Iron Point Coal Lease Tract—should an average of 10 ft of coal be extracted in a panel of critical to supercritical width in the D-seam, followed by an average of 10 ft of coal from the B-seam—the following maximum vertical displacement (maximum subsidence) is projected:

  1. D-seam extraction first—mining occurs in undisturbed ground; maximum average subsidence = 6.0 ft (0.6 X 10 ft, from *Figure K-3, Maximum Vertical Displacement* for Longwall).

  2. B-seam extraction later—mining now occurs in disturbed ground; maximum average subsidence = 7.0 ft (0.7 X 10 ft, see *Figure K-3, Maximum Vertical Displacement for Longwall*).

  3. Total maximum average subsidence for extraction of both coal seams would therefore be 13.0 ft (6.0 + 7.0 ft).

3.5 Compression Arches and Related Stresses

Compression arches commonly develop above areas where the coal is being mined. These arcuate zones of compressive stress transfer much of the weight of the overburden to the arch abutment zones ahead, behind, and on either side of the area being mined (somewhat like stone-arched bridges transfer their weight and load to the bridge abutments).

- Compression arches can support relatively high compressive stresses, compared to tensile stresses, because rock is strong in compression but weak in tension. The major abutment zones in a longwall mining operation are (1) the caved zone (gob) behind the supports, (2) the unmined coal ahead of the face, and (3) the gate road pillars.

- In a longwall mining operation, where the roof rocks cave behind the support, much of the weight of the overburden is borne by the re-compressed caved material (gob). This minimizes the abutment load (stress) on the coal ahead of the face. Abutment stresses are smallest where the roof caves close to the longwall supports, because the length of the arch and the supported weight of the overburden are reduced.

- Caving, which is necessary to form an abutment zone, is controlled by the lithology of the roof rocks. Thin layered shales, siltstones, and claystones cave readily, whereas thick sandstones may cave with difficulty. Coal mine bumps and rock bursts are minimized both in number and magnitude where the roof rocks consist of shales and claystones, but may occur in greater frequency and magnitude where the roof rocks are strong sandstones.

- Mining stresses increase with increasing overburden depth. Room-and-pillar extraction mining becomes significantly more difficult overburden more than 1,500-2,000 ft thick, because mine roofs and pillars become unstable. Miners often are forced out of an area before complete caving can occur, thus causing additional abutment stresses and attendant bumps and rock burst. The longwall method overcomes much of the roof and pillar stability problems, so that abutment stresses are lower than in coal mined by the room-and-pillar method. Longwall mining in the D-seam in Elk Creek Coal Lease Tract and the D- and B-seams in the Iron Point Coal Lease Tract should be viable to 2,500 ft or more, because the roof rocks above both of these seams should cave readily.

- Bumps and rock bursts commonly occur in greatest number and magnitude where a large uncaved area develops behind the longwall supports, or where large pillars, which can store large amounts of strain energy, occur in the abutment zones of the compression arch. It is necessary to achieve a balance between gate road pillar and barrier pillar design for mine stability and safety of personnel and to also design for minimal subsidence effects.

- For a given point of observation on the surface, the compression arch has dissipated when subsidence is complete. Subsidence is nearly complete when critical extraction length and width is 1.0 to 1.4 d. For mining panels of subcritical width, the arch may not dissipate until an adjacent panel is mined. Also more subsidence will likely occur when the next longwall panel is mined.

3.6 Seismic Activity

Coal bumps and rock bursts have been a cause of sporadic seismic activity in the Somerset area over the last 30 years or so. For example, a bump occurred at about 4 AM in the fall of 1968 in the Somerset mine that awoke local residents and shook buildings in the Somerset area severely.

- More than 4,000 seismic events, with magnitudes of as much as 3.8 on the Richter scale, were recorded near or within 30 mine areas in the contiguous Wasatch Plateau and Book Cliffs coal mining districts from January, 1978 to March, 1996 (Arabasz and others, 1997).

- The author and others recorded thousands of seismic events on a seismic network operated by the USGS in the Sunnyside district during the mid-to late 1960s. One episode of seismic events occurred beneath the Geneva mine in the Sunnyside mining district during October, 1967 (Dunrud, 1998, p 70-81). The seismic events, which were all of sufficient magnitude to locate a hypocenter (x, y, z location), ranged from 1.3 to 3.1 on the Richter scale. Hundreds more seismic events, too small to locate on the seismic network, occurred over a period of a few days in the general area where the bumps occurred. Though mine damage was very severe (at least 10,000 tons of coal was explosively released), these major seismic events fortunately occurred 3,000 ft to 6,000 ft below the bump-damaged mine area near faults and a large fault zone that was detected in seismic refraction studies.

- In the Somerset area, during seismic monitoring in the 1970s, the author did not detect a seismic interaction between coal mine bumps/rock bursts and faults, similar to that found in the Sunnyside mining district. An interaction between any faults present is therefore not anticipated in the Elk Creek and Iron Point Coal Lease Tracts.

- In room-and-pillar mining areas at Somerset, increased seismic activity occurred with increased stresses near and within the mine workings. The stress increases often occurred where unstable roof conditions and or bumps in the pillars forced miners out of an area before extraction is complete. Caving in these areas was not extensive enough to cause transfer of abutment stresses to the caved area.

- Coal mine bumps and rockbursts, with accompanying seismic activity are often the result of incomplete or irregular room-and-pillar mining practices (Dunrud, 1976, p. 28-29). Earth tremors generated by bumps and rock bursts in the Somerset mine during the mid-1990s were felt over a large area. The seismic event was of sufficient magnitude to be recorded at the USGS National Earthquake Center in Golden, Colorado and to be verified as being in the abandoned Somerset mine.

- Tremors of this magnitude may have some impact on sensitive structures, as well as the least stable landslide and rockfall areas. Although the author observed no rock falls or landslides at his monitoring site in Hubbard Creek at the mouth of Iron Point Gulch when the Rulison shot (Richter magnitude 5.2) was detonated.

- In planned longwall mining in the Elk Creek and Iron Point Coal Lease Tracts, seismic activity is projected by the author to be significantly lower than in the previously-mined room-and-pillar extraction in the area. Because extraction is complete in the panels, abutment stresses are more effectively transferred to, and supported by, the caved zones. An exception to this general protection would be where the mine roof rocks are strong, and do not cave until a large area (perhaps a distance of 100-300 ft and the width of the mining panel) of coal is extracted. A tremor (seismic event), or series of tremors, will be likely when caving does occur. Rocks above the D- and B-seams are shales, siltstones, and thin sandstones. These rocks will likely cave readily behind the longwall supports. Therefore the abutment stresses should remain at a minimum.

- Based on the author's knowledge of conditions in the Somerset mining area, future seismic activity, due to bumps and rock bursts caused by previous mining in these abandoned mines, is likely to be of greater magnitude, and consequently have more impact on sensitive structures and areas, than the seismic activity produced by longwall mining in the Elk Creek and Iron Point Coal Lease Tracts.

4.0 GEOLOGICAL AND GEOTECHNICAL FACTORS INFLUENCING SUBSIDENCE

4.1 Structure

The attitude of the bedrock, lineaments, faults, joints, and cleat is considered in the design of the mining panels. In the Elk Creek and Iron Point Coal Lease Tracts, the bedrock dips northeastward at about 5 degrees, is not faulted, and is not transected by any major lineaments. This gentle dip will not likely alter subsidence analysis to any extent, and will give latitude to design the most effective panel orientation to recover maximum coal resources. The dominant lineament and joint directions, based on a plot of lineaments from a Skylab 2 color infrared image (Dunrud, 1976, p. 15) are North 30-35 East, North 65-70 West, and North 75-80 West. The dominant cleat directions are about North-South and East-West.

- Orientation of joints in the roof rocks and the cleat in the coal commonly controls the way the roof rocks break and cave and how the coal breaks off when cut by the longwall machine. For example:

  1. The roof caves readily behind the longwall supports where joints in the roof rocks are oriented nearly parallel to the longwall face.
  2. The coal may break off in large chunks, however, where the coal cleat is oriented parallel to the longwall face. The longwall face may therefore need to be oriented so that the cleat and longwall face directions diverge 10 degrees or more.

4.2 Strength and Behavioral Properties of the Rocks

These properties control the amount and rate of subsidence. Strong, brittle sandstones and siltstones, for example, may break and cave to the mine floor in larger blocks and fragments than softer, more yieldable shales and siltstones, which controls the bulking factor of the caved debris.

- The height of caving above the mine workings is reduced, for example, where the roof rocks consist of strong sandstones compared to weak shales. However, the height of fracturing is greater for strong, brittle sandstones compared to weak, more yieldable shales.

4.3 Stratigraphic Sequence

The stratigraphic position of strong and weak rocks within the overburden, in addition to the rocks near the mine workings, commonly affects subsidence in various ways.

- Strong, brittle sandstones, on the order of 50 to 100 ft thick, for example, tend to reduce the amount of subsidence compared to weak, more yieldable shales.
- However, strains are often greater in these sandstones, because their greater compressive strength produces more extension in the tension zone than do the weaker, yieldable shales.

- The so-called Bowie Sandstone, ranging from about 50 to 150 ft thick, which underlies the D-seam, may reduce the amount of subsidence caused by mining the B- seam compared to the amount of subsidence caused by D-seam mining.

4.4 Moisture Content

Wet rocks in the mine roof and overburden tend to reduce the bulking factor of the caved rocks near the mine level and also tend to cause the rocks to be weaker and more yieldable than their dry counterparts. This reduction in bulking factor is because wet rocks usually are weaker (in compressive, shear, and tensile strength) compared to their dry counterparts.

- For a given stratigraphic sequence and coal extraction thickness, subsidence amount and affected area generally increase with moisture content. In saturated strata, for example in the U. K. and former Yugoslavia, maximum subsidence reportedly ranges from 0.9 to 0.98 times the coal extraction thickness in disturbed ground, and the draw (limit) angle ranges from 30 to 45 degrees (vertical reference) (Dunrud, 1998, p. 85-99).

- In the Elk Creek and Iron Point Coal Lease Tracts, average maximum vertical displacement (subsidence) is projected to range from 0.5 to 0.7 times the coal extraction thickness (0.5 to 0.7t) and average 0.6 times the coal extraction thickness (0.6t) in undisturbed ground and 0.6 to 0.8 t and an average of 0.7 t in disturbed ground. The draw angle in these essentially dry overburden rocks is projected to be 10 to 20 degrees (vertical reference), with an average of 15 degrees.

5.0 TOPOGRAPHIC FACTORS AFFECTING SUBSIDENCE

5.1 Rugged Terrain

The rugged terrain in the two lease tracts will likely affect subsidence amounts and surface impacts when compared with gentler terrain. Subsidence commonly is less in valleys and more on ridges. Fewer cracks occur in valleys than on ridges, because the valleys are more stable as a result of complete lateral constraint. Consequently subsidence impacts are likely to be greater than they would be in subdued terrain, because the lateral constraint is reduced to nearly zero on steep valley slopes.

- Strains and displacements on steep slopes, particularly cliffs, may cause cracks on the order of a few inches to possibly 1 ft wide and 25 to 50 ft deep, compared to a fraction of an inch to a few inches wide and a few feet deep in the gentle terrain of the valley bottoms. Cracks will tend to be widest (perhaps ½ft to l ½ ft wide) and deepest (possibly 75 to 100 ft) along prominent joints and fractures on the steepest slopes and cliffs, which, in turn may become less stable and more susceptible to landslides and rockfalls. See *Figure 11, Geologic Hazards Map*, and *Figure 14, Subsidence Potential Map*, in the attached EIS "Figures Volume."

- Landslides and rockfalls will be most likely where mining is planned near the outcrop, where tilts and strains are greatest. The greatest impact is projected to occur where the tilt direction parallels the slope gradient, and thus further increases the slope. See *Figure 11, Geologic Hazards Map*, in the attached EIS "Figures Volume."

5.2 Variable Overburden Thickness

For any mining panel width and coal extraction thickness, the maximum subsidence amount, tilt, and strain commonly decrease with increasing overburden depth. A single panel may range from supercritical in shallow overburden to subcritical in deeper overburden.

- Gate road pillars will tend to yield more with increasing overburden depth, such that two or more adjacent panels begin to behave more and more like a superpanel at overburden depth greater than 1,000 to 1,500 ft. At these depths, the pillars will likely yield to the level of the recompacted, caved, and broken rock in the longwall panel.

6.0 SUBSIDENCE EVALUATION OF LONGWALL MINING OF THE D-SEAM IN THE ELK CREEK AND THE D- AND B-SEAMS IN THE IRON POINT COAL LEASE TRACTS

The author uses the subsidence prediction method for trough subsidence developed by the National Coal Board (NCB, 1975).

- The NCB is the world's foremost organization studying and analyzing subsidence caused by underground mines. Using their expertise, which was developed over many decades by this organization, coal is routinely mined under cities, rivers, and other sensitive structures and areas. Knowledge of NCB analysis of subsidence processes and parameters is therefore very important to evaluate and minimize impacts in a proposed mining area.

- The NCB method—which is basically a conceptual model consisting of the fundamental factors of coal extraction thickness, subsidence amount, mining width, and overburden depth—can be adjusted for overburden lithology, moisture conditions, mining panel width, and coal extraction thickness.

- The NCB method has been adapted and modified for local conditions observed in the North Fork Valley in both room-and-pillar and longwall mining areas, and also is based on subsidence data from underground mining operations in New Mexico, Utah, and Wyoming. In addition, information and experience is drawn from other coal mining areas of the United States and the former Yugoslavia.

6.1 Subsidence Zones

There are four zones to consider and analyze, in the trough subsidence process, based on studies and experience by the author and others (for example, Peng, 1992). These are the (1) caved, (2) fractured, (3) continuous deformation, and (4) near-surface zones. See *Figure K-2, Typical Longwall Subsidence Cross-Section*.

6.1.1 Caved Zone

This zone, according to Peng (1992, p. 1-2) ranges from 2 to 8 coal extraction thicknesses (2t to 8t), depending on lithology and moisture content of the roof rocks.

- In the Elk Creek and Iron Point Coal Lease Tracts, 2 to 4 coal extraction thicknesses (2t to 4t), with an average of 3 (3t), are projected, based on the author's experience with this lithology and the commonly dry conditions in the rocks above the D-seam.
- Where the D-seam is locally water-bearing, however, the height of the caved zone may range in thickness from 3 to 5 times the coal extraction thickness. Therefore, where the D-seam and overlying rocks are totally dry, the height of the caved zone will be closer to 2t, particularly where the roof rocks are sandstone; where the D-seam is saturated, the height of the caved zone will be closer to 5t, particularly where the roof rocks are shales.

6.1.2 Fractured Zone

Rocks in this zone undergo fracturing within rock layers and along the boundaries of these layers. It is transitional to the underlying caved zone. See *Figure K-2, Typical Longwall Subsidence Cross-Section*. For a given lithology, displacements and intensity of fracturing tends to decrease upward. Thus water (hydraulic) conductivity also tends to decrease upward.

- Peng (1992, p. 143) states that the upper one-third of this zone has only minor, unconnected fractures and thus has only minor potential for water conductivity, that most of the water conductivity potential is in the lower two-thirds of this zone, and that the water conductivity increases downward.
- According to Peng (1992, p. 6-8), the height of fracturing is a function of lithology and thickness of stratigraphic layers. According to Liu (1981), the fracture zone ranges from 20 to 30 times the coal extraction thickness (20 to 30t) for overburden comprised predominantly of hard, brittle sandstones and limestones, whereas, the zone ranges from 9 to 11 times the coal extraction thickness (9 to 11t) for overburden consisting predominantly of soft shales and claystones.
- For the Elk Creek and Iron Point Coal Lease Tracts, the height of the fractured zone is projected to be 10 to 20 times the coal extraction thickness (10 to 20t), with an average of 15 times the coal extraction thickness (15t). This projection is based on the best information available to the author in the literature and on the author's experience in the area.

6.1.3 Continuous Deformation Zone

This zone, which is transitional to the underlying fracture zone, occurs from the upper limit of the fractured zone upwards to the near-surface zone. See *Figure K-2, Typical Longwall Subsidence Cross-Section*. The downwarping process (trough subsidence) causes various rock units in the overburden to deform as multiple plates (or multiple beams in two dimensions).

- The downwarping of strata as multiple plates causes tensile strains to develop where convex-upward curvature occurs above the neutral surface, and compressive strains where concave-downward curvature occurs below the neutral surface of the plate (see *Figure K-2, Typical Longwall Subsidence Cross-Section*, inset e,f,g,h).

- Crack depth is therefore controlled by the distance to the neutral surface of the rock unit being downwarped, because compression occurs below the neutral surface. Therefore cracks are not vertically continuous, but are controlled by the thickness of the individual rock units.

- Slippage (flexural slip) also occurs at the surfaces between the rock units behaving as plates.

6.1.4 Near-Surface Zone

Nearly all measurements are made at the top (surface) of this zone. It typically consists of one or more of (1) bedrock, (2) weathered bedrock, (3) colluvium, (4) alluvium.

- The behavior of the material in this zone is a function of its continuum deformational characteristics (i.e. its ability to yield or stretch without rupturing or breaking). Bedrock is typically the most rigid (least yieldable) (except perhaps in a claystone); alluvium commonly is the least rigid (most yieldable).

- The near-surface zone, therefore, has an extremely variable ability to stretch without rupturing—bedrock, rigid (except for some claystones); weathered bedrock, typically less rigid; colluvium, somewhat yieldable to yieldable; alluvium, typically very yieldable.

- The following subsidence crack case history in the small valley of Bear Creek observed by the author in the mid-1970s, is a local example of the varying deformational behavioral response to extension (horizontal tensile strain) with type of material. The cracks correlated with room-and-pillar mining of the B-seam. The extraction thickness was 10 ft; the overburden depth ranged between 250 and 500 ft. Records show that mining was completed in December, 1976.

    1. Crenulate (irregular), en-echelon (offset) cracks as much as 10 in to 1 ft wide, and 25 to 50 ft long trending roughly parallel to the stream and the pillar extraction line, were observed by the author in weathered bedrock and colluvium a few feet thick on the east side of the valley 75 to 100 ft above Bear Creek. The crack depth was difficult to estimate, because extensive sloughing had already occurred. However, the cracks likely ranged between 3 and 10 ft.

    2, Cracks 6 to 10 in wide and 100 to 200 ft long were also mapped across Bear Creek. These cracks occurred on either side of the extraction panel and trended nearly parallel to the boundaries. The cracks crossed the road and extended eastward upslope and westward towards the stream.

The cracks, as mapped by U.S. Steel personnel, show that the cracks on either side of the panel intersected the stream, however the author has no knowledge that they extended to the stream.

3. Small, crenulate cracks a fraction of an inch to an inch or two wide, 10 to 25 ft long, and a few inches to perhaps one foot deep, could be seen in colluvium an estimated 10 to 20 ft thick, and located 15 to 30 ft above the stream.

4. No cracks were observed in saturated alluvium underlying the Bear Creek stream. The thickness of the alluvium was estimated to be 10 to 15 ft and the underlying colluvium 30 to 50 ft. The author did not observe any loss of flow downstream in Bear Creek from this area, and no loss was reported to the author's knowledge.

    1. There are two possibilities for this observation of no cracks and no flow loss:

        A. The alluvium stretched without rupturing when mine subsidence occurred beneath the stream channel.

        B. Cracks in the alluvium healed and sealed naturally prior to the author visiting the site. Healing and sealing of any cracks occurring in stream alluvium could be viable because their downward limit is the neutral surface of the stream alluvium; the unit is likely to be in compression below this surface. In addition, siltation during periods of increased flow could fill any cracks present.

7.0 SUBSIDENCE PARAMETERS ANALYZED IN THE ELK CREEK AND IRON POINT COAL LEASE TRACTS

- Subsidence parameters analyzed are (1) maximum vertical displacement (commonly called subsidence) (S); (2) tilt (M), (3) positive and negative horizontal strain (extension, E; compression, -E); (4) draw (limit) angle (δ); and (5) break angle ( ). See *Figure K-1, Typical Subsidence Profile for Longwall.*

7.1 Maximum Vertical Displacement (Subsidence) (S)

Maximum vertical displacement, or what is commonly considered subsidence, ranges from 0.5 times the coal extraction thickness (0.5 t) for critical and supercritical room-and-pillar extraction panels in undisturbed ground of the Somerset mine to 0.98 times coal extraction thickness (0.98 t) in overburden disturbed by dewatering in the former Yugoslavia (Dunrud, 1998, p. 89). See *Figure K-3, Maximum Vertical Displacement for Longwall.*

- For undisturbed ground and critical to supercritical longwall mining panels, S is projected to range from 0.5t in valleys to 0.7t in ridge areas and average 0.6t in the Elk Creek and Iron Point Coal Lease Tracts.

- For disturbed ground (critical to supercritical panels), S is projected to range from 0.6t in valleys to 0.8t in ridge areas, and average 0.7t in these lease tracts.

- Calculated ranges of S in undisturbed and disturbed ground, for various overburden depth ranges, are displayed in Table 1, Maximum Vertical Displacement. Calculations are based on a panel width of 800 ft and a maximum coal extraction thickness of 12 ft in the D-seam for the Elk Creek Coal Lease Tract, and a panel width of 900 ft and maximum coal extraction thickness of 10 ft in the D-seam and 10 ft in the B-seam for the Iron Point Coal Lease Tract:

- Maximum Vertical Displacement (S) (first 4 columns are D-seam mining only; 5th column—Iron Point D & B assume D-seam mining is in undisturbed ground and B-seam mining is in disturbed ground; add 10% to column 5 if D-seam mining is in disturbed ground):

Table 1
Maximum Vertical Displacement (S)
(D seam=12 ft for Elk Creek Tract; D and B seams=10 ft for Iron Point Tract)

Overburden Depth (ft)	Elk Creek Undisturbed (ft)	Elk Creek Disturbed (ft)	Iron Point Undisturbed (ft)	Iron Point Disturbed (ft)	Iron Point D & B Seams (ft)
100 - 250	7.2	8.4	6.0	7.0	13.0
250 - 500	7.2	8.4	6.0	7,0	13.0
500 - 1,000	7.2 - 6.0	8.4 - 6.9	6.0 - 5.5	7.0 - 6.3	13.0 - 11.8
1,000 - 1500	6.0 - 4.1	6.9 - 4.8	5.5 - 4.0	6.3 - 4.5	11.8 - 8.5
1,500 - 2,000	4.1 - 2.4	4.8 - 3.0	4.0 - 2.6	4.5 - 3.0	8.5 - 5.6
2,000 - 2,500	2.4 - 1.6	3.0 - 1.8	2.6 - 1.7	3.0 - 2.0	5.6 - 3.7

7.2 Maximum Tilt (M)

Maximum tilt (called slope by NCB, 1975; but called tilt by the author to distinguish it from the slope of the terrain) is plotted and analyzed in terms of the fundamental ratios of maximum vertical displacement to overburden depth (S/d) versus the ratio of mining panel width to overburden depth (W/d). See *Figure K-4, Tilt and Strain.*

- These ratios are fundamental because subsidence is proportional to mining width and inversely proportional to mining depth. Therefore, a plot of S/d versus W/d will provide tilt and strain values for mining at any depth—whether subsidence occurs above mines only 60 to 100 ft deep, as in the Sheridan, Wyoming area, to mines more than 2,000 ft deep in various areas of Utah.

- Maximum tilt (M) is projected to range from a maximum of 3.5 S/d for mining panels of subcritical width to 3.0 S/d for mining panels of critical to supercritical width. See *Figure K-4, Tilt and Strain.*

- Calculated maximum tilt ranges (in percent) for various overburden depths for the Elk Creek and Iron Point Coal Lease Tracts are shown in the table below; for the Elk Creek Coal Lease Tract, mining panel width (W) = 800 ft and maximum coal extraction thickness (t) = 12 ft; for the Iron Point Coal Lease Tract, W = 900 ft and t = 10 ft for the D-seam and also the B-seam.

- Maximum tilt will likely be twice the amount projected in Table 2, over stiff barrier pillars planned between longwall panel groups in the Elk Creek Coal Lease Tract. Tilt occurring on each side of the barrier probably will cause a doubling of the tilt value, because the overburden and ground surface will tilt towards both adjacent longwall panels.

- Maximum tilt in the first 4 columns of Table 2, is for D-seam mining only in the Elk Creek and Iron Point Coal Lease Tracts, using subsidence values in Table 1, Maximum Vertical Displacement. In column 5, Table 2, maximum tilt for both D-seam mining and B-seam mining in the Iron Point Coal Lease Tract is shown, assuming that D-seam mining is in undisturbed ground and B-seam mining is in disturbed ground. Add 10% to the values in column 5 if D-seam mining is in ground disturbed by prior mining. A 10 foot extraction thickness is assumed for mining in both the D-seam and the B-seam.

Table 2
Maximum Tilt (M)
(D seam=12 ft for Elk Creek Tract; D and B seams=10 ft for Iron Point Tract)

Overburden Depth (ft)	Elk Creek Undisturbed (%)	Elk Creek Disturbed (%)	Iron Point Undisturbed (%)	Iron Point Disturbed (%)	Iron Point D & B Seams (%)
100-250	21.6 - 8.6	25.2 - 10.1	18.0 - 7.2	21.0 - 8.4	39.0 - 15.6
250-500	8.6 -4.3	10.1 - 5.0	7.2 - 3.6	8.4 - 4.2	15.6 - 7.8
500-1,000	4.3 - 1.8	5.0 - 2.0	3.6 - 1.7	4.2 - 1.9	7.8 - 3.6
1,000-1,500	1.8 - 0.8	2.0 - 1.1	1.7 - 0.9	1.9 - 1.0	3.6 - 1.9
1,500-2,000	0.8 - 0.4	1.1 - 0.5	0.9 - 0.5	1.0 - 0.5	1.9 - 1.0
2,000-2,500	0.4 - 0.2	0.5 - 0.2	0.5 - 0.1	0.5 - 0.3	1.0 - 0.4

7.3 Maximum Horizontal Strain

Maximum horizontal tensile and compressive strain (E, -E) is determined using local data that is compared to National Coal Board (NCB, 1975) information. See *Figure K-4, Tilt and Strain.*

- Strain data is derived from the York Canyon longwall mine in New Mexico (Gentry and Abel, 1978) and the Somerset room-and-pillar mine. Horizontal strain is plotted in terms of the ratio of maximum vertical displacement to overburden depth (S/d) versus the ratio of mining panel width to depth (W/d).

- Horizontal tensile strain is projected by the author to range from 1.0 S/d for critical and supercritical mining panels to 1.25 S/d for subcritical panels, whereas compressive strain is projected to be -1.0 S/d for critical and supercritical mining panels to as much as -2.5 S/d for subcritical panels.

- Calculated maximum horizontal and compressive strain ranges (in percent; example: a horizontal strain of 0.036=3.6%=36,000 micro inches/inch) for the Elk Creek and Iron Point Coal Lease Tracts in Tables 3 and 4 below; for the Elk Creek Lease Tract, mining panel width (W) equals 800 ft and maximum coal extraction thickness (t) equals 12 ft; for the Iron Point Coal Lease Tract, W = 900 ft and t = 10 ft for both the D- and B-seams.

- Maximum horizontal tensile and compressive strain in the first 4 columns of Table 3 and 4 are given for D-seam mining only in the Elk Creek and Iron Point Coal Lease Tracts using maximum vertical displacement values of Table 1.

- Maximum horizontal tensile strain above large barrier pillars planned between panel groups in the Elk Creek Coal Lease Tract will likely be twice the amount shown on Table 3, because (as with tilt) the overburden and surface will subside both ways above these rigid barriers, and therefore double the horizontal tensile strain.

- Tensile and compressive strains in column 5, Tables 3 and 4 are given for mining both the D-seam and the B-seam in the Iron Point Coal Lease Tract, assuming that D-seam mining is in undisturbed ground and, of course, subsequent B-seam mining is in disturbed ground. Add 10% to the values in column 5 if D-seam mining is in ground disturbed by prior mining. A 10 foot extraction thickness is assumed for both D-seam and B-seams mining in the Iron Point Coal Lease Tract.

Table 3
Maximum Horizontal Tensile Strain (E)
(D seam=12 ft for Elk Creek Tract; D and B seams=1- ft for Iron Point Tract)

Overburden Depth (ft)	Elk Creek Undisturbed (%)	Elk Creek Disturbed (%)	Iron Point Undisturbed (%)	Iron Point Disturbed (%)	Iron Point D & B Seams (%)
100 - 250	7.2 - 2.9	8.4 - 3.4	6.0 - 2.4	7.0 - 2.8	13.0 - 5.2
250 - 500	2.9 - 1.4	3.4 - 1.7	2.4 - 1.2	2.8 - 1.4	5.2 - 2.6
500 - 1,000	1.4 - 0.6	1.7 - 0.7	1.2 - 0.6	1.4 - 0.6	2.6 - 1.2
1,000 - 1,500	0.6 - 0.3	0.7 - 0.4	0.6 - 0.3	0.6 - 0.3	1.2 - 0.6
1,500 - 2,000	0.3 - 0.15	0.4 - 0.2	0.3 - 0.2	0.3 - 0.2	0.6 - 0.4
2,000 - 2,500	0.15 - 0.1	0.2- 0.1	0.2 - 0.1	0.2 - 0.1	0.4 - 0.2

Table 4
Maximum Horizontal Compressive Strain
(-E; all strain values in table are negative)

Overburden Depth (ft)	Elk Creek Undisturbed (%)	Elk Creek Disturbed (%)	Iron Point Undisturbed (%)	Iron Point Disturbed (%)	Iron Point D & B Seams (%)
100 - 250	7.2 - 269	8.4 - 3.4	6.0 - 2.4	7.0 - 2.8	13.0 - 5.2
250 - 500	2.6 - 1.3	3.4 - 1.7	2.4 - 1.2	2.8 - 1.4	5.2 - 2.6
500 - 1,000	1.3 - 0.7	1.7 - 0.8	1.2 - 0.6	1.4 - 0.6	2.6 - 1.2
1,000 - 1,500	0.7 - 0.5	0.8 - 0.6	0.6 - 0.4	0.6 - 0.5	1.2 - 0.9
1,500 - 2,000	0.5 - 0.3	0.6 - 0.3	0.4 - 0.3	0.5 - 0.3	0.9 - 0.6
2,000 - 2,500	0.3 - 0.15	0.3 - 0.2	0.3 - 0.2	0.3 - 0.2	0.6 - 0.4

7.4 Draw Angle (limit angle, angle of draw)

The draw, or limit angle (ϕ), defines the limit of subsidence at the surface in relation to a given mining panel at depth. Therefore, by projecting a series of straight lines (or planes) from around the edges of a given mining panel to the surface, the surface area affected by extracting the coal in the panel can be determined.

- As previously mentioned, the draw angle for room-and-pillar and longwall mines in the Somerset area ranges between 8 and 21 degrees (Dunrud, 1976, p. 22-23). The draw angle at the West Elk longwall mine ranges from 9 to 18 degrees. The draw angle (vertical reference) is therefore projected to be between 10 and 20 degrees, with an average of about 15 degrees.

- Although the draw angle defines the limit of surface subsidence, the break angle, as discussed next is perhaps more important in a subsidence analysis where hydrologic impacts are of particular importance.

7.5 Break Angle

The break angle ( ) provides a means of defining the areas or zones of maximum tensile strain above a mining panel or superpanel, and therefore, defines zones of maximum hydrologic impact. Most cracks in the overburden and at the surface occur in zones of maximum tensile strain, and is therefore also the zone of greatest water conductivity.

- The break angle reportedly averages 10 degrees less (steeper angle) than the draw angle (Peng and Geng, 1982). Based on observations in the Somerset area, the break angle ranges from a few degrees from vertical, but averages about vertical (zero degree break angle).

- The location of zones of maximum hydraulic conductivity are both dynamic and static.

- The **dynamic zone** of fracturing is located above the longwall mining face and thus moves at the same velocity as the face. Therefore, these cracks tend to appear as the face moves beneath a point of observation, and then close again as the face moves out of the area of mining influence--a distance of 1.2 d to 1.4 d. Measurements by DeGraff and Romesburg (1981), on surface bedrock above room-and-pillar coal mines in Utah, showed that these cracks healed as mining was completed in the area.

- The **static zone** of fracturing occurs above mining panel boundaries and rigid gate road pillars and barrier pillars. These cracks are likely located in a 100-foot zone above panel boundaries and also in a 150- to 200-foot zone above gate road pillars between the panels and barrier pillars between panel groups. In a superpanel configuration, most cracks within will likely heal and seal again. In the Somerset area, cracks in this static zone commonly remain open until the forces of weathering, mass wasting, and erosion fill them in. The author observed complete healing and sealing of weathered shales and siltstone in about 10 years after coal was mined by room-and-pillar methods in the Somerset area. The same concepts and time frame should apply to longwall mining methods.

- The maximum projected depth of cracks in the continuous deformation and near-surface zones is a function of the thickness of the material behaving as a plate (beam in two dimensions) as shown in *Figure K-2, Typical Longwall Subsidence Cross-Section*. Under conditions of lateral constraint, as in the valleys and other areas of gentler relief, cracks will not likely propagate further than the location of the neutral surface of the material. Cracks wider than a few inches and deeper than 10 to 20 ft are estimated to be rare in these areas.

- As discussed earlier in section 5.1, cracks on ridges and near steep valley walls and cliffs are projected to be considerably wider and deeper than in the valleys, because lateral constraint is greatly reduced compared to the valleys.

7.6 Rate and Duration of Subsidence

Subsidence at a given point on the surface begins when the longwall face is beneath that point, is 50 percent complete when the longwall face is 0.3 to 0.4 times the overburden depth (0.3-0.4 d) beyond the point, and is more than 90 percent complete when the longwall face has passed 1.2d to 1.4d beyond the given point.

- Subsidence rate, duration, and attendant impacts are therefore a function of mining rate. The faster and more uniformly longwall mining is accomplished, the less time any fractures occurring in the dynamic zone will be open. Any fractures present in the static zone will, of course, remain open after mining is finished and until filling, healing, and sealing processes are complete.

- Dynamic tilt and horizontal strain reportedly decrease with increasing speed of longwall extraction (Peng, 1992, p. 20-21). For example, as the rate of movement of the longwall face in a West Virginia coal mine increased from 10 ft/day to 40 ft/day:

- Maximum dynamic tilt decreased an average of 42 percent.
- Maximum dynamic tensile strain decreased by an average of 22.5 percent
- Maximum dynamic compressive strain decreased by an average of 48 percent.

8.0 IMPACTS OF SUBSIDENCE ON STRUCTURALLY SENSITIVE AREAS

8.1 Longwall Mining in Unstable Areas—Landslides, Rockfalls, and Geologic Hazard Areas

These unstable areas occur naturally, but may be impacted by mining activities.

- It is therefore important to have baseline data and an inventory of all landslide, rockfall, and generally unstable areas before mining begins, so that movements due to natural processes can be excluded from any potential mining impacts. See *Figure 11, Geologic Hazards Map*, in the attached EIS "Figures Volume."
- It is also important to have an assessment plan to distinguish between mining-related impacts on unstable areas and other activities, such as road construction. An example of this is the large landslides that occurred during and after construction of State Highway 133 on the south side of the North Fork of the Gunnison River between the West Elk Mine and Paonia Reservoir. No mining had yet been done in this area.
- Tilt and strain caused by subsidence may accelerate movement in landslide and rockfall areas - areas where movements would eventually occur due to natural causes. This is most likely on steeper slopes during periods of increased precipitation.
- Large tilt and horizontal strain values caused by longwall mining in shallow overburden, such as mining close to the coal outcrop may cause the greatest mining impacts on areas that are already unstable.

    1. Tilt values greater than about 5 - 10% (250 - 500 ft overburden depth or less) may impact areas that are already prone to landslides or rockfalls, particularly where the tilt direction parallels the downslope direction, and therefore increases the slope by the tilt amount.
    2. Horizontal tensile strain values greater than about 2 to 3 percent (250 - 500 ft overburden depth or less) also may accelerate the natural landslide or rockfall process, particularly during periods of high or increased precipitation.

8.2 Mining Beneath Streams

As discussed previously in Section 6.1.4, pillars were extracted during the mid-1970s beneath Bear Creek without any observed temporary or permanent impact on stream flow.

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- Pillars were extracted in a panel 400 to 460 ft wide located 220 to 300 ft (average of about 260 ft) beneath Bear Creek. The pillars in a zone 350 ft wide beneath Bear Creek were only partially extracted. The remaining pillars on either side of this zone were completely extracted. The original pillar dimensions were 60 ft square. Two adjacent sides of each pillar in the zone were further mined, so that the remaining pillars measured 30 to 35 ft on a side.

- Vertical displacement, tilt, and strain cannot be accurately calculated, because of the uncertainty of yield values of the small pillars left under Bear Creek. However, based on the size and length of the cracks observed in the area (described in section 6.1.4), the area above these small pillars very likely was subject to maximum tilt and horizontal strain projected for the 250 ft to 500 ft overburden depth category in the Elk Creek and Iron Point Coal Lease Tracts (Tables 2-4).

- It is very important to note that there was no observed or reported impact on stream flow in Bear Creek due to the subsidence in the mid-1970s to the present time.

8.2.1 Driving Entries Beneath Terror Creek

Five entries may be driven in the B-seam under Terror Creek near the southwest part of the Iron Point Coal Lease Tract. These entries would be used to provide mining access and haulage to a lease tract west of Terror Creek (known as Bowie No. 1 Pod). This analysis examines the impacts if no extraction of pillars under Terror Creek occurs. Only five entries 20 ft wide, 10 ft high, and square pillars on a minimum of 75-ft centers will be driven. When subsidence must be avoided under drainages, pillars must be much larger than normally used in room-and-pillar mining, thus minimizing or preventing their failure.

The following tilt and horizontal tensile and compressive strain can be projected for these entries, first by using the subsidence prediction methods for Elk Creek and Iron Point Coal Lease Tracts and second, by analyzing the stability of the pillars in the 5-entry system with a widely accepted procedure.

First, subsidence will be determined above the individual entries (i. e. the entries will be considered separately), as follows: the overburden depth ranges from 300-600 ft (use 300 ft will be used to be conservative) where the entries are planned. The planned mining width is 20 ft, the coal extraction thickness (t) is 10 ft. The mining width to depth ratio (W/d) equals 20/300 = 0.067; Maximum predicted vertical displacement (fig. 3) is 0.025 t

1. Maximum tilt is thus determined to be: 1.0 x 0.025 x 10 ft/300 ft =0.25/300 = 0.00083 = 0.08%. See *Figure K-4, Tilt and Strain.*

2. Maximum horizontal tensile strain equals 0.5 x 0.025 ft x 10 ft/300 ft = 0.125 ft/300 ft = 0.00042 = 0.04%.

3. Maximum horizontal compressive strain equals -2.5 x 0.025 x 10 ft/300 ft = 0.625 ft/300 ft = -0.0021 = -0.21%

- The impact predicted for driving five 20-ft entries beneath Terror Creek at a 300-ft depth, using this separate entry concept, seems negligible. Maximum tilt and horizontal strain values are lower than those projected for the 2,000 to 2,500 ft overburden depth category for horizontal compressive strain. Of course no cracks would occur in areas undergoing compressive strain.

Second, the potential impact of driving five entries beneath Terror Creek will be determined by considering the mine entries as an interrelated system of mine openings separated by coal pillars. Under this procedure, the capability of the pillars to support the overburden weight will be evaluated and analyzed, using the same entry width as before, but maximum overburden depth to be conservative. Subsidence will then be determined based on the projected yield of the pillars due to stresses produced by the weight of the overburden.

Average vertical stress on each pillar in the entry system was calculated by Bowie Resources using the Analysis of Longwall Pillar Stability (ALPS) program provided to them by the National Institute for Safety and Health (NIOSH). The input parameters to the ALPS program were:

(1) Seam thickness - 10 ft,

(2) Overburden depth - 600 ft (most conservative),

(3) Entry width - 20 ft,

(4) Crosscut centers - 75 ft (minimum dimension; may be 100 ft),

(6) Entry centers - 75 ft (minimum dimension; may be 100 ft),

(7) In-situ coal strength - 900 psi (accepted value-based on nation-wide pillar-stability studies),

Using the ALPS program originally developed by the US Bureau of Mines, a factor of safety of 1.88 is calculated. A factor of safety of 1.3 indicates that no pillar yield will occur. The 1.9 factor of safety indicates that no pillar yield will occur, and therefore no vertical displacement, tilt, and horizontal strain due to pillar yield will occur.

8.3 Driving Entries Beneath the Curecanti-Rifle 230/345 kV Powerline

No impact to the powerline is anticipated due to driving entries beneath the powerline. Maximum tilt and horizontal tensile and compressive strain values caused by driving five entries beneath Terror Creek are projected to range from 0.08% (tilt) and 0.04% (horizontal tensile strain) to -0.21% (horizontal compressive strain) above each entry, using the most conservative input parameters for the subsidence calculation.

- Also, pillar stability analysis of the 5-entry system shows that no pillar yield will occur, and therefore, vertical displacement, tilt, and strain due to driving the entries equals zero.

8.4 Longwall Mining Beneath Terror Creek Reservoir

The potential impact of mining beneath Terror Creek Reservoir, which the author has been asked to assess, will only be fully known when all site-specific geologic information about dam and reservoir stability and source of water is known. However, maximum tilt and horizontal tensile and compressive strain can be projected for the reservoir area based on calculations for the Iron Point Coal Lease Tract as it currently exists.

- The Terror Creek Reservoir is located north of the currently projected Iron Point Coal Lease Tract. The overburden depth, relative to the B- and D-seams, ranges between 2,000 and 2,500 ft. Maximum tilt (M) and horizontal strain (E, -E) values due to longwall mining 10 ft of coal in the D-seam in undisturbed ground, followed by mining 10 ft of coal in the B-seam in disturbed ground (longwall panel width - 900 ft), are determined, as follows (note: because the Terror Creek Reservoir is located on a broad ridge, maximum vertical displacements for undisturbed ground and disturbed ground will be used from *Figure K-3, Maximum Vertical Displacement for Longwall*; a sample calculation is given for maximum tilt):

  1) **D-seam-d=2,000 ft:** M = (3.5)(0.30x10ft)/2,000 ft = 10.5/2,000 ft = 0.00525 = 0.52%
     D-seam-d=2,500ft: M = (3.25)(0.2x10ft)/2,500 ft = 6.5/2,500 ft = 0.0026 = 0.26%
     M ranges from 1.2% (d=2,000 ft) to 0.5% (d=2,500 ft) for mining both D- and B-seams.

  2) E ranges from 0.2 to 0.1% for mining the D-seam; E from 0.4 to 0.2% for mining both D- and B-seams.

  3) -E varies from -0.3 to -0.2% for mining the D-seam: -E from -0.7 to -0.4% for mining both D- and B-seams.

- Tilt and strain amounts projected for the Terror Creek Reservoir are the maximum static strains that would occur above the mine boundary areas. Cracks as much as an inch wide (and of unpredictable length) are projected to occur in the massive Ohio Creek sandstone if the D-seam is mined. Cracks as much as 2 inches wide are projected if both seams are mined. These cracks are predicted because lateral constraint is significantly less in this ridge area than it would in valleys.

- If a longwall panel were designed so that the reservoir would be above the panel center, then it would be subjected to only the temporary, dynamic tilt and strain during mining, and therefore the impact would be significantly less than if impacted by the static tilt and strain above mine panel boundaries.

8.4.1 Options in Regard to Mining in the Area of the Terror Creek Reservoir

Terror Creek Reservoir is outside any proposed lease tract boundary. However, to address issues raised during EIS scoping, three options were considered with regard to mining in the area of the Terror Creek Reservoir. These options would be to:

1) Mine only to a buffer zone that would be designed to protect the dam, reservoir, and water source from any possible subsidence impacts.

2) Mine only the D-seam beneath the reservoir.

3) Mine both the D- and B-seams beneath the reservoir.

Option 1, leave an adequate buffer zone to protect the reservoir. The first step under this option would be outline the buffer area that involves the dam abutments, the reservoir, and the water source area. The second step is to calculate the buffer distance around this area that could not be impacted under this option, using conservative angles of draw.

- Angles of draw are projected to range from 10 to 20 degrees in the Iron Point Coal Lease Tract, with a projected average of 15 degrees. However, in establishing an adequate buffer zone, conservative values greater than 15 degrees should perhaps be used. Table 5 below indicates the buffer distance outward from the limits of the impacted area for various angles of draw.

The buffer zone calculated around the outward limits of the dam, the reservoir, and the water source area, using a 25 degree angle of draw, should be adequate. No angle of draw more than 21 degrees has been recorded in the Somerset area to the author's knowledge.

Option 2, Mine only the D-seam beneath Terror Creek Reservoir. Under this option, maximum tilt and horizontal strain values range from 0.5% (for d=2,000 ft) and 0.3% (d=2,500 ft) for tilt; 0.2 (d=2,500 ft) to 0.1% (d=2,500 ft) for horizontal tensile strain; -0.3 to -0.2 for horizontal compressive strain. Cracks of as much as one inch may occur above mine boundaries in the upper Ohio Creek sandstone of the Mesaverde Formation.

Option 3, Mine both the D-seam and the B-seam beneath Terror Creek Reservoir. Maximum tilt and horizontal strain under this option are calculated to range from 1.2% (d=2,000 ft) to 0.6% (d=2,500 ft) for tilt; 0.4% (d=2,000 ft) to 0.2% (d=2,500 ft) for horizontal tensile strain; -0.7% (d=2,000 ft) to -0.4% (d=2,500 ft) for horizontal compressive strain. Cracks as much as 2 inches wide may occur above the mine boundaries in the Ohio Creek sandstone.

- Under options 2 and 3, detailed studies and tests should be done in the reservoir site area to determine how the maximum tilt and strain projected for the site would impact stability, and also how seismic events of as much as about 3.0 on the Richter scale would impact stability. Modeling studies may also be needed. The following suggestions may be useful to the studies (there may be others):

  1) Determine dam stability before mining and after mining the D- and then the B-seams. Also determine the geologic and geotechnical characteristics of the material with which the dam was constructed.

Table 5
Buffer Distance Outward From Impacted
Reservoir and Water Source Area

Depth of Coal (feet)	Angle of Draw (Degrees)	Buffer Distance (feet)
Relative to the D-seam		
2,000 - 2,500	10	353 - 441
2,000 - 2,500	15	536 - 670
2,000 - 2,500	20	728 - 910
2,000 - 2,500	25	933 - 1,166
2,000 - 2,500	30	1,155 - 1,433
Relative to the B-seam (using 275 ft vertical separation between the top of the B-seam and the top of the D-seam)		
2,275 - 2,775	10	404 - 489
2,275 - 2,775	15	610 - 744
2,275 - 2,775	20	828 - 1,010
2,275 - 2,775	25	1,060 - 1,294
2,275 - 2,775	30	1,314 - 1,602

- Under options 2 and 3, detailed studies and tests should be done in the reservoir site area to determine how the maximum tilt and strain projected for the site would impact stability, and also how seismic events of as much as about 3.0 on the Richter scale would impact stability. Modeling studies may also be needed. The following suggestions may be useful to the studies (there may be others):

  2) Determine dam stability before mining and after mining the D- and then the B-seams. Also determine the geologic and geotechnical characteristics of the material with which the dam was constructed.

  3) Determine reservoir stability before and after mining the D- and then the B-seams. Also determine the geological and geotechnical characteristics of the material on which the dam is founded.

  4) Determine the source of water: Is it from (a) near the base of the Wasatch Formation or (b) the top of the Mesaverde Formation (Ohio Creek sandstone). The author noted a permeable cobble/gravel zone near the base of the Wasatch Formation in some areas during geologic mapping of the area. Should this be the source of water, it would be important to determine whether clays occur beneath this zone, or if this zone rests on top of the Ohio Creek sandstone.

- Subsidence impacts would be greatest if the source of water occurs in a gravel/cobble zone resting directly on top of the Ohio Creek sandstone, or if the source of water is at the top of the Ohio Creek sandstone. Subsidence impacts would be significantly less if a clay layer (perhaps 10 to 20 ft thick) occurs between the water source and the Ohio Creek sandstone.

- With detailed, site-specific knowledge of the reservoir site (including the dam, reservoir foundation, and location of the water source) and proper orientation of the mining panels, it may be possible to mine under Terror Creek Reservoir in the D-seam, and perhaps even the B-seam, if the highly yieldable claystones 15 ft or more thick occur beneath the dam, reservoir, and water source. Of course, this would depend on the results of a detailed geologic, geotechnical, and modeling evaluation of the general reservoir site and the site response to local seismic activity on the order of 3.0 on the Richter scale.

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Appendix L

Socioeconomic Report

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SOCIOECONOMIC REPORT

Note: Figures associated with this appendix can be found in the "EIS Figure Volume."

1.0 SOCIOECONOMICS

This report provides an overview of the socioeconomic aspects of the existing conditions of the area, as well as the impacts associated with pending decisions on the proposed Iron Point and Elk Creek Coal Lease Tracts.

For purposes of the socioeconomic assessment, primary, secondary, and tertiary study areas are defined see Figure L-1. Socioeconomic Study Areas:

- The primary study area is the geographic area that is anticipated to be most directly affected by the proposed project. The primary study area is defined to include all communities within Delta County. This is expected to be the primary area where most mine related effects are experienced, based in large part on residence locations of mine-related employees.
- The secondary study area is the geographic area expected to be indirectly affected by the proposed project. The larger secondary study area includes all of Delta and Gunnison Counties. Gunnison County may also experience direct fiscal effects. Other Gunnison County direct effects will be focused largely in the unincorporated area of Somerset due to the geographic location of the mines away from other Gunnison centers of population.
- The tertiary study area covers the even larger geographic area — expected to experience broader cumulative social effects due to the proposed project. Economic and social changes in the tertiary area also provide a context for other non-mine related changes occurring in the primary and secondary study areas. For this analysis, the tertiary study area is defined to include the seven-county Central Western Slope area of Delta, Gunnison, Mesa, Montrose, Ouray, Pitkin, and San Miguel. This broader study area will be denoted as the Central Western Slope area.

2.0 AFFECTED ENVIRONMENT

This section discusses current and historic trends that influence study area population. The evaluation of the affected population defines existing conditions. Information presented in this section is used to assess the effects of different mine development alternatives.

2.1 Population and Demographics

Information on population for the study areas has been compiled from a variety of sources beginning with the 1980 and 1990 U.S. Censuses. Updated estimates (since 1990) were obtained from the State of Colorado Demography Section and U.S. Census Bureau.

As of 1998, approximately 26,600 residents live in Delta County, the primary study area. Population has increased by 3% annually since 1990. This rate of growth is faster than the rate of growth occurring in the broader secondary and tertiary study areas as well as statewide. A

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large portion of primary study area population growth experienced since 1990 has occurred in the City of Delta (35%).

The City of Delta is the largest incorporated community in the primary study area with 5,600 residents residing within the city limits — 21% of all residents living in the primary study area. After Delta, the next largest cities are Orchard City, Cedaredge, Paonia, Hotchkiss and Crawford, respectively. Together, the incorporated communities within the primary study area account for nearly 50% of total Delta County population.

Table 1. Population Trends (1980-1998)

	Total Population			Annual % Change	
Geographic Area	**1980**	**1990**	**1998**	**80-90**	**90-98**
Cities/Towns:					
Cedaredge *	1,184	1,380	1,920	1.5%	4.2%
Crawford *	268	221	280	-1.9%	3.0%
Crested Butte	959	878	1,130	-0.9%	3.2%
Delta *	3,931	3,654	5,600	-0.7%	5.5%
Gunnison	5,785	4,636	5,195	-2.2%	1.4%
Hotchkiss *	849	744	915	-1.3%	2.6%
Marble	30	64	85	7.9%	3.6%
Mount Crested Butte	272	336	365	2.1%	1.0%
Orchard City *	1,914	2,218	2,805	1.5%	3.0%
Paonia *	1,425	1,403	1,765	-0.2%	2.9%
Pitkin	59	53	205	-1.1%	18.4%
Subtotal Study Area Cities	16,676	15,587	20,265	-0.7%	3.3%
Delta County	21,225	20,980	26,619	-0.1%	3.0%
Gunnison County	10,689	10,273	12,456	-0.4%	2.4%
Subtotal Delta + Gunnison	31,914	31,253	39,075	-0.2%	2.8%
Central Western Slope	153,251	167,430	204,903	0.9%	2.6%
State of Colorado	2,889,735	3,294,473	3,970,971	1.3%	2.4%

* Note: Cities in primary study area.

Source: E.D. Hovee & Company using information provided by U.S. Census Bureau.

The two-county secondary study area has a combined population of 39,075 as of 1998. The majority (or 68%) of the population lives in Delta County. Secondary study area population has increased at an average rate of 2.8% annually since 1990, with the greatest increase between 1993-1995.

According to data provided by Oxbow, West Elk, and Bowie mine operators, as well as severance tax data, an estimated 88-96% of Bowie, Oxbow (Sanborn), and West Elk mine employees live in Delta County.[1] Over 56-67% live in the Paonia/Hotchkiss area. Only a small proportion (4-12%) live outside of Delta County. Most of these workers live in the Somerset area, a small unincorporated community just east of Paonia in Gunnison County.

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[1] The range in the reported proportion of mine employees living in Delta County stems from the information reported by each information source. Bowie reported that 141 (or 88%) of its 160 mine employees live in Delta County. In contrast, West Elk reported that 274 (or 96%) of its 285 mine employees live in Delta County.

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Table 2. Where Mine Workers Live

Community	Bowie	Oxbow	West Elk	Severance Tax
Cedaredge	9	16	11	6
Crawford	13	21	—	41
Delta	20	14	35	33
Hotchkiss	31	34	59	29
Orchard City	—	—	—	9
Paonia	59	74	132	138
Rest of Delta County	9	—	37	22
Total Delta County	141	159	274	278
Gunnison County (including Somerset)	1	7	11	16
Other Counties	18	11	—	—
Total All Workers	160	177	285	294

Source: Information provided by West Elk, Bowie, and Oxbow mines as well as state severance tax records. Severance tax data covers all coal mine employees living in Delta & Gunnison Counties.

Population changes in Delta County, as well as Gunnison County and statewide, are primarily driven by migration trends.[2] During most of the 1980s, Delta County lost population. Between 1983 to 1989, net out-migration averaged 415 people per year. The year of greatest net out-migration occurred in 1987, when 1,120 more residents left than moved to Delta County.

Beginning in 1990, Delta County started to attract a net inflow of new residents. Over the last eight years, an average of approximately 700 net new residents have moved into the study area each year. Between 1993 to 1995 — the period of greatest population growth — the number of net new residents moving into Delta County occurred at an even higher level of 1,100 net new residents per year.

As is further detailed in the discussion of employment, changes in Delta County population tend to closely parallel changes in employment activity. Since 1980, the years of greatest population loss have occurred during periods of declining employment in Delta County. See Figure L-2. Net Migration Trends (1981-1998).

Between 1996 and 1997, approximately 2,320 new residents moved into Delta County.[3] Almost 30% came from other Central Western Slope counties, 80% of them from neighboring Mesa and Montrose counties. Another 25% of new residents came from other counties in Colorado. Of the 45% of new residents moving into Delta County from outside Colorado, most (57%) came from other western states

Approximately 1,970 residents left Delta County between 1996-1997. About 30% moved to other Central Western Slope counties; primarily to neighboring Mesa and Montrose counties. Another 27% moved to other Colorado counties.

The Colorado Department of Local Affairs forecasts that Delta County's population can be expected to increase by another 16,000 residents over the next 20+ years. This equates to an average growth rate of 2.2% annually, a rate of growth below what has occurred over the last eight years. Population in the secondary study area is forecast to grow at a similar rate annually (2.1%). (See Figure L-3. Population Forecast (1995-2020).)

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[2] Detailed population growth data is only available at the county level.

[3] Information reflects the latest data available from the Internal Revenue Service (IRS) which publishes county-to-county migration flow data based on annual federal income tax returns.

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2.2 Housing

Current household size in the primary study area is 2.40 persons per household. Household size in the primary study area has been declining, a result of smaller households moving into the primary study area. See Figure L-4. Changes in Household Size (1990-1998).

Households in the two-county secondary study area are slightly smaller than primary study area households. Secondary study area households average 2.38 persons per unit. Household size in the secondary study area has also been falling.

In 1997, 347 single family homes were sold in Delta County, 176 fewer sales than in 1994. This decline in sales volume corresponds well with the slowing in net in-migration of new residents.

Average sales price of a single family home in Delta County varies by community, from $68,900 to $101,800. Highest priced homes can be found in the Cedaredge and Paonia areas. However, the reported average sales price in the Paonia area has declined from $139,900 in 1995 to $89,800 in 1997.

Table 3. Single Family Home Sales (1994-1997)

	Single Family Sales				Average Sales Price			
Community	**1994**	**1995**	**1996**	**1997**	**1994**	**1995**	**1996**	**1997**
Delta County:								
Cedaredge Area	118	148	96	83	$76,501	$94,646	$98,690	$101,800
Crawford Area	21	15	16	15	$70,944	$64,233	$71,050	$68,860
Delta Area	251	196	206	152	$59,098	$65,873	$73,330	$83,820
Hotchkiss Area	54	53	36	38	$72,993	$90,889	$94,260	$87,640
Paonia Area	79	81	58	59	$99,557	$139,883	$100,170	$89,810
County Total	523	493	412	347	$71,050	$89,310	$84,760	$88,910
Gunnison County:								
Town of Crested Butte	21	10	12	19	$251,776	$338,000	$274,906	$328,040
Gunnison Area	130	109	84	46	$89,159	$117,480	$141,035	$114,786
East River Valley	55	26	23	43	$181,395	$308,270	$284,338	$294,660
Other Rural Area	61	46	31	35	$77,010	$121,308	$133,887	$123,420
County Total	267	191	150	143	$118,170	$155,920	$172,240	$199,320

Source: Delta County Assessor and the Gunnison County Assessor's Office.

In the larger secondary study area, 490 single family homes were sold in 1997. The number of home sales declined (by 300) from 1994 to 1997, for similar reasons as in the primary study area.

Single family homes in Gunnison County are considerably more expensive than Delta County. Average sales price of a home in Gunnison County ranges from $114,800 to $328,000, with highest priced homes reported in the resort community of Crested Butte. Rapid price escalation is also occurring in the nearby East River Valley communities.

2.3 Demographic Characteristics

An estimated 11.7% of the residents living in the primary study area represent racial and ethnic minorities, above the secondary study area (at 9.9%), but well below statewide levels (at 21.0%). Hispanic residents represent the largest minority/ethnic group, accounting for 10.5% of the Delta County population. See Figure L-3. Ethnic Background of Study Area Populations (1997).

Almost 19% of residents new to the primary study area since 1990 are minorities. The fastest-growing minority group is Hispanic, representing 16.9% of Delta County population growth experienced since 1990. See Figure L-6, Change in Ethnic Background of Study Area Populations (1990-1997).

Primary study area residents tend to be older than secondary study area residents. Almost 49% of primary study area residents are age 45 and older, compared to 41% in the secondary study area.

Rand McNally's *Places Rated Retirement Guide* rated Delta County in the top one-third of communities nationally for climate, housing, health care, personal safety, economics, and recreation. Locally and regionally an in-migration of retirees is being experienced, particularly of young retirees (residents age 45 to 64).[4]

The primary study area population is aging. Over 69% of the population growth in the primary study area comes from persons aged 45 and older. Seniors (65+) account for 23% of all new residents. Figure L-7, Population Age Characteristics (1997).

This trend is somewhat similar to secondary study area and statewide trends. Almost 60% of population growth statewide and 65% of growth in the secondary study area has consisted of residents aged 45 and older. However, only 11% of statewide growth has come from residents age 65 and older. See Figure L-8, Changes in Population Age Characteristics (1990-1997)

2.4 Employment

Participation in the Delta County labor force is well below participation rates in the larger secondary study area and statewide. In 1997, only 50% of the population age 16 and older in Delta County were employed or actively seeking employment. In the secondary study area, 60% of residents age 16 and older were employed or seeking employment. The two-county secondary study area's higher participation rate is due to the 78% rate being experienced in Gunnison County reflecting a much higher percentage of working age adults living in that county. The statewide labor force participation rate is 72%. See Figure L-9, Labor Force Participation Rate (1997).

Delta County's low labor force participation rate appears to be related to its relatively high proportion of retired residents. As mentioned earlier, 49% of Delta County's population is age 45 and older, and 23% is age 65 and older.

Historically, the unemployment rate in Delta County has averaged between 4.7% and 6.6%, higher than the statewide rate. However, changes in Delta County's unemployment rate have paralleled statewide labor trends, as has unemployment in the secondary study area. See Figure L-10, Unemployment Rate Trends.

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[4] Based on a socioeconomic profile prepared by Region 10, the economic and community development agency for Delta, Hinsdale, Gunnison, Montrose, Ouray, and San Miguel Counties.

As of April 1999, the unemployment rate in Delta County was 5.9%, more than twice the statewide rate of 2.7%. Local unemployment consistently runs about 1½-2 percentage points above the statewide average.

Over the last 16 years, the job base in Delta County has been more affected by cyclical changes in national and global economic conditions than the entire state. Between 1984 and 1987, Delta County lost over 1,900 jobs, one-third in agriculture and farm-related businesses. Since 1987, almost 3,500 net new jobs have been created; 28% in the service sector.

However, the extent of cyclical variation in Delta County is less severe than for the larger secondary study area. Gunnison County appears to experience more higher peaks and lower valleys in employment trends over time. See Figure L-11, Total Employment Trends (Part- and Full-Time Employees).

Delta County population migration trends appear to closely parallel employment growth trends. For example, years of greatest net out-migration coincide with years of significant job losses, illustrating that when Delta County loses jobs, local population growth tends to slow or decline. See Figure L-12, Delta County Employment Growth and Population Migration Trends.

In 1996, approximately 11,370 workers were employed in Delta County (including self-employed). Employment has increased by almost 27% since 1980. Fastest-growing industries include services (+98%), wholesale trade (+78%), and construction (+62%). The only industries reporting a decrease in employment are agriculture and farm (-20%), finance, insurance, and real estate (-23%), and mining industries (-65%).[5]

As of 1996, self-employment is estimated to represent the largest single job sector in Delta County. The number of non-farm self-employed workers increased by 21% between 1980 and 1996 in Delta County. Over 30% of all workers are self-employed (non-farm), a greater proportion than in the secondary study area or even statewide.[6]

Over the last 17 years the coal mining industry in Delta County, as well as in the secondary study area and statewide, has gone through a period of economic restructuring. In 1981, the highest year of coal production, nine active coal mines produced almost 3.0 million tons of coal in the secondary study area (covering Delta and Gunnison Counties), representing 15% of total production statewide. By 1986, only three active mines remained producing 1.3 million tons of coal, representing only 8% of statewide production.

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[5] U S Bureau of Economic Analysis (BEA) employment figures for the mining industry are lower than employment levels reported by Bowie, Oxbow and West Elk mines, as well as levels reported through the state's severance tax program. However, BEA's employment data (with the inclusion of self-employed workers) presents the most comprehensive account of total employment.

[6] During E.D. Hovee & Company's survey of area service providers, it was noted that U.S. West now provides three phones in most new houses due to a growing number of home occupation/home office customers. Furthermore, Delta Telecommunications reported that the number of business lines increased by 33% versus only 17% for residential lines. This trend is supportive of a shift toward small cottage, telecommuting, and other related self-employment related activities.

Table 4. Employment Trends by Sector

	Delta County		Delta + Gunnison Study Area		Colorado	
Employment Sector	**1996**	**1980-96**	**1996**	**1980-96**	**1996**	**1980-96**
Agriculture & Farm*	1,616	-20.0%	1,950	-18.8%	68,108	+16.0%
Mining*	123	-65.4%	631	-41.5%	24,796	-42.8%
Construction	912	+61.7%	1,757	+64.8%	163,956	+60.0%
Manufacturing	591	+38.1%	868	+43.5%	211,252	+13.9%
TCPU	365	+3.1%	627	+32.6%	136,083	+60.8%
Wholesale Trade	391	+77.7%	493	+69.4%	108,661	+35.4%
Retail Trade	2,036	+44.6%	4,494	+64.4%	452,080	+64.5%
FIRE	687	-22.7%	1,463	-8.7%	202,364	+26.3%
Services	2,774	+98.4%	5,538	+102.3%	810,435	+118.6%
Government	1,372	+40.2%	3,306	+42.7%	354,377	+20.7%
Total Employment**	11,367	+26.7%	21,127	+38.0%	2,532,114	+53.1%
Self Employment						
Farm	843	-6.3%	983	-6.7%	24,274	-9.5%
Nonfarm	3,426	+21.3%	5,703	+37.7%	475,081	+82.6%

Notes: * Also includes wage and salary farm employment not otherwise included within the agricultural sector. Agriculture and mining employment was not disclosed in 1996 for Delta County. Mining employment was estimated using 1997 covered employment data from the State of Colorado. Agricultural employment is estimated as the difference between total non-disclosed employment and estimated mining employment.

** Self-employed workers are included within each employment sector.

Source: E.D. Hovee & Company using Bureau of Economic Analysis information.

The decline in coal production reportedly resulted from the elimination of federal energy tax credits and coal incentives and the related closure of US Steel's Somerset mine in 1985.[7] Between 1981-86, Delta County went from producing two-thirds of the secondary study area's coal to producing just over one-fourth.

Since 1986, the coal mining industry in the secondary study area has rebounded. However, the primary production of coal has shifted towards Gunnison County. For example, in 1997, 8.1 million tons of coal were produced, but only 804,000 tons came from Delta County mines. Also, the secondary study area is now producing almost 30% of the state's coal. See Figure L-13, Coal Production Trends (000s short tons).

The mines that survived the downturn of the mid-1980s have become more efficient and capital-intensive. While total coal production was declining between 1980 and 1986, production per worker steadily increased, primarily due to the closing of less efficient mines.

The amount of coal produced per worker increased dramatically over the last 17 years. In 1980, a total of 2,300 tons of coal was being produced per mine worker; by 1990, this had increased more than two-fold to almost 4,800 tons per worker. With the introduction of longwall technology, output per worker has increased even more substantially to 12,800 tons per worker. Longwall technology also has allowed the coal mines to recover a greater proportion of available coal. See Figure L-14. Coal Mining Productivity Trends.

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[7] Western Slope Environmental Resource Council, *The Western Slope Environmental Report*, April 1999.

The distribution of coal sales will vary over time depending on domestic and global market conditions. The geographic market for Colorado coal also is affected by transportation costs, with customers in nearby states typically representing major components of demand.

As of 1997, over 94% of the coal produced in Colorado was sold to domestic consumers in the United States (i.e. utilities, industrial plants, and households). About 45% of coal is sold in-state. Of the coal shipped out-of-state from Colorado mines, 12% is sold to consumers in Tennessee, 8% to Texas, 8% to Utah and 20% to other states. Less than 6% is exported, most of which is shipped to Mexico. See Figure L-15, Distribution of Colorado Coal Sales (1997).

In recent years, the price received from coal produced in Colorado has been on the decline, decreasing by an average of 2.4% per year. In 1993, Colorado coal mines received, on average, $20.35 per ton. By 1997, the average price of coal per ton was only $18.46. Reduced market pricing has placed greater competitive pressure on mine operators to focus on productivity improvements, including longwall technology. See Figure L-26, Average Mine Price of Colorado Coal.

In summary, both Delta and Gunnison Counties have experienced substantial employment growth in recent years from 1980-1996. This overall employment growth has occurred even as mining-related employment has declined, leading to a more diverse economy in both the primary and secondary study areas. While mine employment has declined, mines have restructured to achieve substantially greater productivity in a more competitive domestic and global market.

2.5 Income

In 1996, personal income per capita in Delta County averaged $16,400 (after adjusting for inflation), 4% below the $17,000 per person living in the secondary study area and 36% below $25,700 average experienced statewide.[8] Primary area personal income growth per capita has lagged behind per capita income growth in the secondary study area and the state as a whole. Between 1980 and 1996, personal income per capita in Delta County increased by only 19%, compared to 24% in the secondary study area and 33% statewide. See Figure L-17, Total Personal Income Per Capita (Inflation Adjusted).

In 1996, 43% of personal income in Delta County was derived from earned income sources (wages and salary, proprietor's income, and other labor income), down from 52% in 1980. As of 1996, residents in Delta County earn less in wages, salary and proprietor's income than from transfer payments (e.g., retirement, unemployment insurance, government payments) and investment income. Only 32% of personal income is from wage and salary sources, down from 36% in 1980.

The total amount of transfer payment income received by Delta County residents doubled (after adjusting for inflation) between 1980 and 1996. Because the amount of income an individual (or household) receives from transfer payments tends to be less than could be earned from labor, the rapid growth in transfer payment income compared to earned income has tended to dampen the level of income growth experienced in Delta County compared to the larger secondary study area and entire state. See Figure L-18, Sources of Personal Income.

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[8] Personal income is the amount of income an individual receives annually before taxes. It includes wages, salaries, proprietors' land other labor income; investment income; and transfer payments.

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Earned income in the secondary study area and statewide also accounts for a declining share of personal income. However, earned income still represents the majority (54%) of total personal income in the secondary study area and 70% of total personal income statewide.

In 1996, average wage per worker in Delta County was only $15,700 compared to $17,100 in the entire secondary study area and $28,400 statewide. Highest-paid wages were in the mining sector where the average Delta County worker earned $47,600, more than three times the county wage average for all sectors and $18,400 above the next highest paying sector.

Most rapidly increasing wage levels in Delta County are in finance, insurance and real estate (+57.8%) and government (+14.9%); a trend also being experienced in the secondary study area and statewide. However, average wage for finance, insurance and real estate workers is only $11,100, second lowest paying sector in Delta County.

Table 5. Average Wage per Worker by Sector (inflation adjusted)

	Delta County		Delta + Gunnison Study Area		Colorado	
Employment Sector	**1996**	**1980-96**	**1996**	**1980-96**	**1996**	**1980-96**
Agriculture & Farm*	$6,100	+1.5%	$5,500	-19.6%	$16,300	+36.5%
Mining*	$47,600	-15.4%	$53,300	+6.4%	$52,500	-4.8%
Construction	$19,400	-23.1%	$22,100	-11.5%	$31,600	-7.3%
Manufacturing	$17,600	-13.0%	$17,000	-15.2%	$40,900	+11.1%
TCPU	$29,200	-7.3%	$26,100	-15.7%	$50,700	+19.8%
Wholesale Trade	$18,800	-6.2%	$19,500	-13.8%	$39,400	+6.6%
Retail Trade	$12,000	-20.1%	$12,000	-15.2%	$15,600	-8.4%
FIRE	$11,100	+57.8%	$14,300	+71.4%	$27,600	+60.8%
Services	$13,600	-8.7%	$14,200	-2.5%	$25,500	+16.3%
Government	$24,700	+14.9%	$25,400	+9.8%	$31,300	+22.7%
All Sectors**	$15,700	-4.9%	$17,100	-5.2%	$28,400	+9.1%
Self Employment (Nonfarm)	$10,800	-19.6%	$11,800	-11.8%	$17,800	-2.8%

Notes: * Also includes wage and salary farm income not otherwise included within the agricultural sector. Agriculture and mining income were not disclosed in 1996 for Delta County. Mining income was estimated using 1997 covered employment data from the State of Colorado. Agricultural income is estimated as the difference between total non-disclosed income and estimated mining income.

** Self-employment income is included within each employment sector.

Source: Bureau of Economic Analysis.

Delta County is attracting a net inflow of new residents. Between 1996-1997, a net 350 new residents moved into Delta County.[9] New residents moving into Delta County have higher incomes than those moving out. Median income of new residents averages $18,500 compared to an average median income of $14,500 for residents leaving the county.

2.6 Community and Public Services

As part of the EIS process, area community and public service providers have been contacted to ascertain information regarding current services provided together with possible public service effects due to prospective changes in mining activities in the Bowie and Somerset areas of Delta and Gunnison Counties. This assessment of possible impacts on community and public services focuses on the primary study area in Delta County, where the bulk of mine employees currently resides.

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[9] Information reflects the latest data available from the Internal Revenue Service (IRS), which publishes county-to-county migration flow data based on annual federal income tax returns.

Representatives of the following community and public service providers were contacted:

- County and municipal governance
- Education
- Ambulance services
- Fire services
- Law enforcement
- Water supply, wastewater treatment and solid waste
- Hospital and medical services
- Electrical utilities
- Social services
- Roads

2.6.1 County and Municipal Governance

The primary study area consists of six incorporated communities, with the rural unincorporated portion of Delta County under the auspices of county government. The Bowie and Oxbow mines are situated in unincorporated Delta County, though a portion of Oxbow operations extend into unincorporated Gunnison County.

Delta County is governed by a three-person elected board of commissioners. Administrative functions are overseen by a non-elected county administrator. Each of the incorporated communities is governed by an elected mayor and city council, except for the City of Delta which has a council-manager form of government.

Gunnison County comprises five incorporated jurisdictions, none of which is closer than 34 miles (Town of Marble) to the Bowie or Oxbow mines. The unincorporated area (including the community of Somerset) is governed by the three-person elected Gunnison County Board of Commissioners.

Delta County's master plan divides the county into seven areas based on watersheds and the communities within each respective watershed. A committee in each planning area is charged with reviewing applications, identifying issues, and establishing standards and regulations.[10]

Delta County has few provisions for planning, land use or local review of construction projects and development. For example, no building permits are required for the county's unincorporated area.

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[10] According to county officials, the fundamental mission of Delta County planning is to protect area resources. Water is considered a particularly important resource, so regulating subdivisions and mobile home parks are particular focuses for the committees.

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Only two of the incorporated communities within the primary study area of Delta County (Paonia and Delta) have an adopted zoning ordinance. Responsibility for land use planning resides in an appointed planning commission which serves in an advisory capacity to the elected city council.

Gunnison County does not have an adopted zoning ordinance covering unincorporated portions of the county. However, the unincorporated areas are governed by a land use resolution. The resolution allows only single family residential. All other uses are reviewed by the Planning Commission on a case-by-case basis. Recommendations are sent to the County Commissioners for a final approval. The unincorporated community of Somerset also is governed by this resolution. Much of the surrounding area is under the jurisdiction of the U.S. Forest Service and Bureau of Land Management.

2.6.2 Education

Public education service providers in the primary study area include the Delta County Joint School District, the Gunnison Watershed School District and the Delta-Montrose Area Vocational Technical Center. Most and perhaps all children of current mine employees attend Delta County Joint School District schools.

Children in the Somerset area of Gunnison County are served by the Delta County Joint School District. Other than those in the Somerset area, students in Gunnison County most likely would not be impacted by an increase in population or enrollment due to mining operations because the next nearest Gunnison County populated community is approximately 100 miles away.

Table 6. Delta County Joint School District Facilities and Capacities

School	**Current** Enrollment	**Facility** Capacity
Cedaredge Elementary School (K-4)	417	500
Cedaredge Middle School (5-8)	233	400
Cedaredge High School	283	350-400
Garnet Mesa Elementary School (K-2)	499	500
Lincoln Elementary School (3-4)	339	450
Delta Middle School (5-6)	340	450
Delta Middle School (7-8)	335	600
Delta High School	672	750
Crawford Elementary (K-8)	150	200
Hotchkiss Elementary School (K-4)	228	300-350
Hotchkiss Middle School (5-8)	147	350
Hotchkiss High School	310	450
Paonia Elementary School (K-4)	297	350
Paonia Middle School (5-8)	175	300-350
Paonia High School	240	450
Totals All Schools	4,665	6,400-6,550

Source: E.D. Hovee & Company, based on contacts with Delta County Joint School District, June 1999.

The Delta County Joint School District serves nearly 4,700 households in Delta County and portions of Montrose, Gunnison and Mesa Counties with 14 schools and a vocational technology school. The district is the county's largest employer with 600 full-time and 50-100 part-time employees.

Enrollment has not increased in the past three years. Overall, the 14 schools in the district are operating at 71%-73% of the indicated 6,400-6,500+ facility capacity. One school (Garnet Mesa

Elementary) is at full capacity, and another school (Hotchkiss Middle School) is operating at less than 50% of indicated enrollment capacity.

Based on contacts with school district personnel, facilities in the Delta County Joint School District are reported to be in generally good condition. However, according to a district representative, Delta School District middle schools need replacing and transportation needs upgrading.

The district's combined operating and capital budget totals $25 million as of 1999. Budget resources are directly tied to the number of students receiving services. Thirty percent of district revenue is generated from local taxes, while the district receives 62% ($15.3 million) from the state equalization fund. Federal programs provide 1.5% of the district's total budget. Four-fifths of district operating expenses are attributed to personnel.

Area schools also provide services of importance to coal mines operating in Delta and Gunnison Counties. The Delta-Montrose Area Vocational Technical Center, five miles south of Delta, provides training for mine workers, emergency medical technicians (EMTs), paramedics and OSHA certification. This vocational program, which includes six Region 10 Colorado counties, employs a full-time program coordinator and a half-time administrative employee. Forty contracted outreach instructors specialize in the various fields of study; 85% of the instruction is outreach, taught on the client's site. In addition to the center located in Delta, there is a mine training facility located in Paonia.

2.6.3 Ambulance Services

Delta County ambulance service is divided between the North Fork Ambulance Service (serving Paonia, Hotchkiss and Crawford) and the Delta County Ambulance Service (serving Cedaredge, Orchard City and Delta). These ambulance services provide basic life support, emergency care and transport. The Delta County Ambulance Service also provides advanced life support and cooperates with the North Fork Ambulance service as needed.

The Delta County Ambulance Service recently formed an ambulance district and plans to contract for services from Delta's County Hospital. While each community has its own paid staff, most EMTs are volunteers. The combined district encompasses 330 square miles with a population of approximately 14,600, 55% residing outside an incorporated city. Two ambulances are kept in Cedaredge at the town hall, while three are located in Delta — one at the hospital and two at the firehouse.

Since the Delta County Ambulance Service has transitioned to a combined ambulance district, it can receive tax revenue. Its annual $850,000 budget is primarily fee-based, with 70% (approximately $600,000) coming from fees and 30% from taxes. A small amount ($50,000) of revenue comes from car registrations. The service has set aside $115,000 for capital improvements. Present budget priorities include salaries, increased staff, and vehicle replacement. The service plans to build two stations with living quarters.

The North Fork Ambulance Service is a volunteer service with a part-time secretary; about 50% of its revenue is derived from grants. Operations budget for the North Fork service is $158,000 annually and the service has $142,000 set aside for capital expenditures. Budget priorities include education, retention and maintaining community involvement.

The North Fork service is membership-based with approximately 6,800 members in an area of about 1,000 square miles, including the unincorporated community of Somerset in Gunnison County. No charge is made for ambulance calls other than the membership fee. Non-members are billed on a fee-for-service basis.

Two ambulances are stationed in Paonia, one in Hotchkiss and one in Crawford. The North Fork service needs an updated mapping system and better communications for dispatching. Because of increases in retired residents and homebuilding in more remote areas, current mapping has become outdated.

To date, little direct impact to ambulance service reportedly has been experienced due to mine operations and associated unit train traffic. According to a published report, unit coal trains are typically 100 cars long, although few cases of trains causing serious delays to emergency medical services have been documented.[11] Generally, delays tend to last two to five minutes; however, not all train crossings are blocked at the same time. Emergency vehicles typically can access unblocked crossings and go around the trains.

To help minimize any serious delays due to possible train blockages, communities in the Delta County Ambulance District alternate the side of the rail line on which the ambulance is parked. However, both ambulance services recognize the potential for greater incidence of delay with mine expansion, especially as rail traffic through the communities increases.

A substantial share of ambulance calls require advanced life support (ALS) EMTs on the ambulance because of the large number of retirees residing in Delta County. Additional ALS-trained EMTs are needed throughout Delta County.[12] The Center's EMT programs have a budget of $100,000. Resources come from the Delta County Joint School District, the state, student tuition, Pell grants and lab fees. More funding is needed for more advanced cardiac monitors, computer training programs and an ambulance for training.

Area ambulance services do not derive direct revenue from the three operating North Fork mines. The mines are not members of the North Fork Ambulance Service, so a fee for service is charged if the North Fork ambulance responds to calls at the mines. North Fork Ambulance Service would like to see the mines buy memberships for its miners.

The Delta County Ambulance Service also has no arrangement with the mines for service, but is interested in arranging coordinated coverage or a contract with the mines for service. Mines usually have on-site first aid staff or EMT personnel and ambulances. Mining companies often use the Delta-Montrose Area Vocational Technical Center to train their own EMT staff, as well as to train mine workers. For example, the vocational school works closely with the Mountain Coal Company.

The coal mines have many employees who are trained EMTs

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[11] "Coal Mining in the North Fork," *Delta County Independent* web site.

[12] Based on telephone contact with the Technical Center's program director.

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2.6.4 Fire Protection

Each Delta County incorporated jurisdiction and much of the unincorporated county is part of a fire district. Five fire districts serve the primary study area and the Somerset portion of Gunnison County.

Delta Fire District 1, located in Delta, has a 22-member volunteer fire department with a service area of 110 square miles. District boundaries stretch to the Mesa County line, the Gunnison Bridge, and the Montrose County line.

The actual service area is approximately double the size of the taxing district. The department serves 12,000-13,000 people. An annexation has been proposed to include the outlying area within District 1's boundaries, although the population is currently already being served by the district.

Fire District 1's current operations budget is $117,600 annually, with a capital budget of $177,000. The fire station is 10 years old, and equipment generally is in good condition. The district has prioritized equipment upgrades as its main current and future needs.

Paonia Fire District 2 (closest to the North Fork mines) provides fire and rescue services to a population of approximately 5,000 in a 30,500-acre (48 square mile) area. Fire District 2's 24 member volunteer department houses its equipment at the Paonia fire station.

Equipment consists of two rescue and quick response trucks, three pumpers, one brush truck, two large tankers and one foam machine. The foam machine was provided by the mines, although the Hotchkiss department does not receive direct revenue from that source.

Fire District 2 rates its equipment as in good shape, but older and in need of upgrades. District representatives foresee a need for a new station and new equipment. District 2's current operations budget is $36,000, with a capital budget of $40,000. Revenues are generated through fundraising ($10,000-12,000 per year) and a property tax mill levy. Recent voter approval to double the mill levy indicates the community's commitment to and awareness of the services provided.

Fire District 3 covers Cedaredge, Orchard City and Austin. A new 9,000 square foot two-story firehouse and six trucks are located in Cedaredge, and a separate substation and two trucks are located in Orchard City. One truck is housed at Grand Mesa from June through October.

Fire District 3 covers an area of approximately 300 square miles. Each community within the district has its own volunteer fire department with 24 volunteers and three to four cadets in Cedaredge, while Orchard City provides another 25 volunteers and five cadets.

Total annual budget for Fire District 3 is nearly $142,000 with a capital budget of $66,350. The district reportedly needs a firehouse in Orchard City and replacements for outdated equipment. Revenue is generated from property taxes and a mill levy.

Fire District 4 in Hotchkiss operates with 26 volunteers. The fire station occupies a small building with narrow doors housing four trucks and a rescue truck. The ambulance district stored the fire trucks until recently. The fire station also has a small meeting room.

The district also operates a separate substation at Redlands Mesa which houses two trucks with eight firefighters in the neighborhood. This district's population consists largely of ranchers, fruit farmers and miners. Most incidents involve sagebrush, oak brush and grazing land fires.

Most Hotchkiss fire department equipment is reportedly in excellent condition. Equipment includes a Class A pumper, a 3,000 gallon tanker, a 1,000 gallon tanker with a pump, and a 1959 Chevy rescue truck. Redlands also has a Class A 500 gallon pumper.

The department's current operations budget is $48,000 annually with a separate $30,000 capital budget. The district's main source of revenue are property taxes, donations and insurance companies. Budget priorities are to introduce compensation for firefighters and to maintain and purchase equipment. Current priorities are to purchase pagers and additional air packs and to update some trucks.

Fire District 5, the Crawford fire department, handles mostly rural farmland with 15 volunteer firefighters. Its major station houses two class A pumpers, a quick response truck, a 2½ ton forest truck and a 3,000 gallon truck. Current operations budget is $26,000. The department plans to develop a separate substation and purchase a new truck.

In the Paonia area, train traffic generally has not created undue delays for emergency fire vehicles. Over the past seven years, one Paonia district incident has been attributed to a train blocking a crossing. (A house burned down as fire trucks waited for a train to pass.)

With reference to possible future effects of expansion involving twice as many potential train trips per day, concern is expressed that emergency vehicles could be delayed in the future. Of 36 rail crossings, seven are situated in Hotchkiss. All of these crossings can be blocked simultaneously with a delay of up to seven minutes.

2.6.5 Law Enforcement

A combination of county sheriff and city police departments provide law enforcement services in the primary and secondary study areas. A number of the smaller incorporated cities do not have their own police force, and so rely on the county for sheriff service.

The Delta County Sheriff's Department has 55 full-time, four part-time employees, and 20 search and rescue staff to serve a countywide population of 28,000. Delta County Sheriff staffing has increased over the last two years. Its jail — a stand-alone facility with a capacity of 57 — is reported to be in excellent condition. The department's annual total budget is $1,165,000.

The Gunnison Sheriff's Department has 23 full-time employees and 12 reservists serving 3,200 square miles with a population of 18,000. The Gunnison Courthouse detention center's 14-bed capacity is often 50%-100% over capacity and is considered to be obsolete. The Gunnison County department's annual budget is $785,300 with a capital budget of $456,000.

For both law enforcement departments, personnel needs are the first priority for added budget resources. Secondary needs include improved maintenance, training and transportation.

The police forces of the towns of Paonia, Hotchkiss, Cedaredge and Delta work cooperatively with the Delta County Sheriff's Department, while the communities of Crawford and Orchard City rely completely on the Sheriff's Department because they do not have police departments

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of their own.[13] The City of Delta has 18 full-time employees as the largest city police force in the primary study area.

Paonia's Police Department, located in a small portion of the town hall, operates with four officers and one part-time employee. The department has five police vehicles between four and six years old, each equipped with radar and video. The department is interested in adding another full-time employee and updating equipment.

Cedaredge employs three full-time law enforcement officers serving approximately 10,000 people, a large year-round tourist population, people with second homes, long-time residents and newcomers, many of them retired. The Cedaredge Police Department has four well-equipped patrol cars in excellent condition with a computer system tied to other departments.

The Cedaredge department's $200,000 annual budget is derived from sales and property taxes. The department has two budget priorities: to increase revenues in order to improve its pay scale and to hire an experienced sergeant. A need to replace patrol cars with four-wheel drive vehicles is also reported.

The Hotchkiss Police Department employs three full-time officers to serve 850 residents, a mix of miners, retirees and newcomers, within the one square mile city limits. Hotchkiss police assist county and state patrol officers as needed.

All the city police departments contacted for this assessment express concern over the effects of coal trains moving slowly through their respective communities. For example, trains can split Hotchkiss down the middle, blocking most of the town. If train traffic doubled to ten trips per day, the community would be more impacted because intersections are typically blocked for five to seven minutes each time

2.6.6 Water Supply, Wastewater Treatment and Solid Waste

Municipal water service is provided for each of the incorporated cities in the primary study area of Delta County. Municipal sewage and wastewater treatment is provided in all of the incorporated communities except Orchard City.

In rural areas, with the exception of portions of the Paonia and Cedaredge rural areas, residents rely on private domestic or community water systems. Permits for Delta County wells on 35 acres or more are granted outright. Wells on parcels smaller than 35 acres need a well permit, granted by the state of Colorado. In unincorporated Delta County, individual septic permits are issued by the county and the local health department. Septic systems need proper leach fields.

Delta County has an EPA-approved landfill in the Tongue Creek area, with a transfer station in the North Fork area. The county also has a voluntary recycling program and has established a task force to deal with issues concerning septic, compost, and agricultural water uses.

Solid waste service is available through private contractors in all communities. Some communities require residents to sign up for garbage service while other communities do not.

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[13] Delta County Sheriff's Department provides police services at no charge.

The City of Paonia provides water, sewer, and solid waste pick-up to city residents as well as water and sewer service to an estimated 1,000 customers situated outside the city limits. Three persons are employed by Paonia's Public Works Department. The city's water fund is $305,700 and the sanitation fund is $523,550, with revenue generated from metered water fees, new water taps and sales tax. Funding also is received from a severance tax for miners who live in the area and from energy impact funding.

Paonia's public works priority is to build a new sewage treatment plant to come into compliance with Environmental Protection Agency (EPA) regulations. The city's sewage treatment plant, built in 1965, is at or over capacity, and experiences extremely high ammonia discharge levels. A new water/sewage treatment plant is being planned for 57 acres below town with a lagoon and land application to correct the ammonia discharge problem. Estimated cost is $4 million.

The city is also studying additional water storage capacity. Current storage consists of a two million gallon tank, a one million gallon reservoir, and a second reservoir with a 500,000 gallon capacity, for total storage capacity of 3.5 million gallons.

Crawford provides water and sewer for approximately 200 households. Water usage is now at 90% capacity. Crawford's lagoon is at 25% of capacity according to EPA standards, and the town is planning more water lines. The town is planning an expansion of the sewer ponds. In Crawford, residents arrange for their own garbage service, available through several companies.

Hotchkiss provides water and sewer with an annual public works budget of $191,500 and a capital budget of $174,700. The town contracts with BFI as a private operator for garbage pick-up, which town residents are required to have. Those who have town water/sewer service but who live outside the town limits, may sign up for garbage service, but are not required to do so.

The City of Delta provides sewer and water service to city residents as well as to areas beyond the city limits which are part of a city annexation program. All Delta residents have city sewer service, with the exception of a few isolated areas which have individual septic systems. Delta's sewage treatment plant is approximately 15 years old and operates well below available capacity.

City of Delta residents are required to subscribe to City of Delta garbage pick-up. Residents of newly-annexed areas may use the City's service or contract with a private hauler.

Delta buys water from the Project 7 water supply in Montrose. Project 7 provides domestic water, regional treatment and transportation (pipes) to communities purchasing water from this company.

Project 7 treatment plant capacity is questionable. The plant was not built to meet new regulations and Project 7 plans to expand the water treatment plant and to add storage. The company is asking customers to create their own localized water reserves.

Orchard City encompasses 11 square miles with a population of 2,300. The city provides domestic treated water but no sewer or septic service. Orchard City's water budget is $1,035,500. Spring and reservoir water is provided to residents and reportedly is plentiful. Each city household is allowed 30,000 gallons per month with households outside the city limits allowed 7,000 gallons per month. A new building for water filtration is under construction at an estimated cost of more than $750,000.

Cedaredge serves a population of 2,000 in town and a portion of the outlying rural area. The three cells of its 25-year old treatment plant have been modernized. Formerly subject to a cease and desist order, Cedaredge's updated water treatment plant is one of three national finalists for a national EPA award for Most Improved Small System Wastewater Treatment. The plant is near capacity, so the city is considering further enlargement/ updating or the construction of a new plant at a different location. Cedaredge utility revenue comes from sales tax together with water and sewer utility bills.

2.6.7 Hospital and Medical Services

Delta Hospital, in Delta, operates as a full-service, general acute care hospital with 49 beds, home health care, a staff of 28 doctors, and 198 full-time and 89 part-time employees. The hospital's primary service area comprises Delta County together with the communities of Olatha in Montrose County and Somerset in Gunnison County.

Delta Hospital's $14 million annual operations and $2.5-$3.0 million capital budgets come from patient billings and a mill levy through a local taxing district. Older citizens tend to use hospitals more intensively so the rising number of retirees living in the area affects Delta Hospital. Most patient care is funded by Medicare/Medicaid, requiring deep hospital discounts. An estimated 80% of Delta Hospital's patients are on Medicare, with private pay patients including insured patients making up the Medicare gap.

Few patients have company health insurance. Just 8% of Delta Hospital patients have business-provided insurance. Remaining patient costs are paid by the patient or by Medicare/Medicaid.

Train traffic represents a concern although EMT service has not been seriously affected because flexible dispatching has been able to work successfully around blockages.[14]

2.6.8 Electrical Utilities

Denver's Tri-State Generation and Transmission Association, Inc. generates and sells power to 32 member cooperatives throughout Colorado, Wyoming and Nebraska. These include Delta Montrose Electric Association and Gunnison Electric serving the primary and secondary study areas.

Delta Montrose Electric's service area includes east Montrose County, western Gunnison County, and all of Delta County. The utility is a non-profit membership cooperative whose members are the residential, commercial, and industrial users within the area's population base of nearly 28,000. Residential customers acccunt for 44% of users, while 28% are small commercial users and 27% are large commercial or industrial customers. The association is expanding by about 1,000 meters annually.

Delta-Montrose Electric employs 34 persons and contracts with another 108 businesses. Its $25 million operations budget covers purchase and distribution of electric power. Operations expansion is at cost to the customers and the utility's capital budget totals $6 million.

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[14] Based on interview with hospital administrator.

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North Fork area mines are members of Delta-Montrose Electric. Electrical improvements made at mining sites are paid for up-front by the mines before capital improvements are made.

To accommodate operating mines, the co-op has made several changes over the years, such as upgrading the Waunita sub-station, located near. Delivery points and land taps were added.

2.6.9 Social Services

Delta County Social Services provides public assistance to low-income families and the elderly. A total of twelve programs including food stamps, low energy assistance, pension assistance, child support enforcement, and child welfare are administered by the agency's staff of 45 full-time employees. Overall, case loads are decreasing except for assistance to the elderly which is increasing, albeit intermittently.

The agency serves Delta County residents and also contracts with Gunnison County to provide services. Its main facility is in Delta and it also rents additional space from churches and other facilities. The agency's own building is considered too small but is in good condition.

2.6.10 Roads

In 1996, average daily traffic (ADT) on Highway 133 east of Paonia was 3,150 vehicle trips per day. Traffic counts in the Somerset area average 2,000 per day and decrease to only 1,050 per day between the Somerset area and town of Marble.

In the Paonia, Hotchkiss, and Crawford area, most of the truck traffic is not mine-related. Coal is primarily moved by train. Mine-related truck traffic consists of getting equipment to and from the mines. The exception is truck traffic from the Bowie mine to a train loadout located five miles away. Highways 133 and 65 are considered scenic routes and are heavily traveled by tourists.

According to a variety of local sources contacted for this socioeconomic assessment, trains are a problem, sometimes simultaneously blocking several crossings in town. Blocking the Delta intersection of Highways 50 and 92 causes traffic jams.

2.7 Fiscal Conditions

Coal mine operations generate a significant amount of federal, state and local government revenues. The federal government receives revenue from land and mineral rights leases, as well as royalties. The State of Colorado receives tax revenues primarily from federal royalties, sales, severance, and income taxes. Local governmental entities receive property, sales, and severance taxes, as well as a share of the federal royalties.

Additional governmental revenues are generated from businesses that supply the mines with goods and services, as well as from the employees of the mines. Local purchases made by the mines generate sales taxes. Also, the income generated by local businesses is subject to state and federal income taxes.

Mine workers also are a source of government revenues. Incomes earned by the mine workers are subject to state and federal income taxes. Household purchases generate sales taxes; and property owned by the mine workers is subject to property taxes.

2.7.1 State of Colorado Revenues

Net state and local revenue collections totaled $6.3 billion in 1998. Revenue collections have been increasing steadily over the last ten years. Since 1989, revenue collections have increased, on average, at a rate of $400 million annually. See Figure L-19, Net State and Local Revenue Collections.

Approximately 87% (or $5.5 billion) of net state and local revenue collections are from taxes levied at the state rather than local level. Fifty-seven percent of state tax collections come from income taxes, about 91% from individuals and only 9% from corporate taxpayers. State sales tax (excluding the local levied portion) accounts for another 26%. Severance tax, which gets redistributed back to local jurisdictions, accounted for only 1% of all Colorado tax collections statewide. See Figure L-20, Major Source of Colorado State Tax Collections (1998).

Between 1989 and 1998, income taxes collected from individuals (including fiduciary agencies) more than doubled. In 1998, the state collected $2.9 billion in net income taxes from individuals, an increase of $1.6 billion (or 118%) over 1989 collections.

Income tax collections from corporate firms have increased at a much slower rate. Between 1989 and 1998, corporate income taxes increased by $108 million, or 65%. See Figure L-21, State Income Tax Collections (1989 to 1998).

This overview of state revenue sources provides a context for the discussion of local tax revenues in Delta and Gunnison Counties.

2.7.2 County Revenues and Expenses

Taxes account for 69% of total county revenues in Delta County and 64% of revenues in Gunnison County. Tax revenues also are increasing more rapidly than all revenues combined.

On the expenditure side, general governmental expenditures account for 55% of county expenditures in Delta County and 59% in Gunnison County. Growth of general governmental expenditure also is outpacing total expenditures in both counties. Public safety represents the number two expenditure item in both Delta and Gunnison Counties.

2.7.3 Retail Sales Tax

Both incorporated cities and counties in Colorado receive sales tax (at locally determined rates) based on the sales of tangible personal property and services, such as furniture, electronics, telephone service, dining, lodging, and other similar items.[15] Retail sales in Delta County have been relatively flat over the last six years. In 1998, approximately $289.2 million in retail sales were generated in Delta County, an increase in retail sales of 29% over 1993 sales levels. Retail sales in Gunnison County (as well as statewide) increased by 41% over this same time period.

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[15] Items exempt from sales tax include gasoline, cigarettes, food for home consumption, prescription drugs and prosthetics, certain machinery and machine tools, etc.

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Table 7. 1997 County Government Revenues and Expenditures

	Delta County	Gunnison County	Comments
Revenues:			
Taxes	$2,862,648	$2,666,437	Delta County taxes increased by 11% since 1995; Gunnison County increased by 42% since 1992.
Licenses & permits	$4,825	$144,069	License & permit fees in Delta County increased by 47% since 1995; Gunnison County increased 42% since 1992.
Intergovernmental	$192,352	$272,772	Intergovernmental revenues increased by 60% in Delta County since 1995; Gunnison County increased by 3% since 1992.
Charges for services	$108,738	$723,976	Delta County charges for services decreased by 30% since 1995; Gunnison County increased by almost 35% since 1992.
Fee accounts	$653,184	—	Fee accounts in Delta County increased by almost 16% since 1995. Gunnison County collected almost $180,000 in 1992 and none in 1997.
Miscellaneous	$354,298	$363,986	Miscellaneous revenues decreased by almost 6% in Delta County since 1995; Gunnison County increased by 67%.
Total Revenues	$4,176,043	$4,171,240	Total Delta County revenues increased by 10% since 1995. Gunnison County revenues increased by 31% since 1992.
Expenditures:			
General government	$2,244,751	$2,587,891	General government expenditures increased by 11% in Delta County since 1995. Gunnison County increased by almost 50% since 1992.
Public safety	$1,564,155	$1,184,952	Public safety expenditures increased by 18% since 1995 in Delta County. Gunnison County increased by almost 24% since 1992.
Public works	$162,853	—	Public works expenditures decreased by almost 25% since 1995 in Delta County.
Health & welfare	$1,500	$449,468	Health & welfare expenditures stayed the same in Delta County from 1995-1997; Gunnison County increased by almost 59%.
Culture & recreation	$121,350	$186,069	Delta County culture & recreation expenditures increased by almost 143% since 1995. Gunnison County increased by almost 69%.
Economic development			
Conservation natural resource	$4,120	—	Conservation natural resource expenditures increased by 6% since 1995 in Delta County.
Intergovernmental			
Capital projects			
Debt service			
Total Expenditures	$4,098,729	$4,408,380	Total Delta County expenditures increased by 13% since 1995. Gunnison County increased by 43% since 1992.
Excess Revenues Over/(Under) Expenditures	$77,314	($237,140)	
Other Financing Sources (Uses)			
Sale of assets			
Loan proceeds			
Operating transfers (In)	$199,892	$347,542	Operating transfers in increased by 23% in Delta County since 1995.
Operating transfers (out)	($150,740)	($10,070)	Operating transfers out increased by almost 5% in Delta County since 1995; Gunnison County decreased by 74% since 1992.
Total Other Financing Sources (uses)	$49,152	$337,472	

	Delta County	Gunnison County	Comments
Revenues:			
Excess Revenues & Other Sources Over/(Under) Expenditures & Other Uses	$126,466	$100,332	
Fund Balance – January 1	$1,428,264	$1,335,651	
Fund Balance – December 31	$1,554,730	$1,435,982	

Source: *Gunnison County, Colorado 1994 Adopted Budget Summary*, December 7, 1993; *Gunnison County, Colorado 1999 Annual Budget*, December 15, 1998; *Delta County, Colorado Combined Statement of Revenues, Expenditures and Changes in Fund Balance, All Governmental Fund Types*, December 31, 1997 and December 31, 1995, compiled by E.D. Hovee & Company, July 1999.

Table 8. Retail Sales by Jurisdiction (1998)

Jurisdiction	Retail Sales (000s)	Population	Sales/Capita	Tax Rate	Total Tax Generated
Delta County:					
Cedaredge	$18,479	1,920	$9,624	1.5%	281,000
Crawford	$1,780	280	$6,357	2.0%	34,000
Delta	$161,247	5,600	$28,794	3.0%	2,369,000
Hotchkiss	$20,718	915	$22,643	2.0%	276,000
Paonia	$19,175	1,765	$10,864	2.0%	306,000
Remainder (unincorporated)	$67,846	16,139	$4,204	2.0%	996,000
Total	$289,245	26,619	$10,866	—	4,262,000
Gunnison County:					
Crested Butte	$51,406	1,130	$45,492	4.0%	1,125,000
Gunnison	$164,655	5,195	$31,695	3.0%	2,727,000
Mount Crested Butte	$33,638	365	$92,159	4.0%	851,000
Remainder (unincorporated)	$109,068	5,766	$18,916	1.0%	525,000
Total	$358,767	12,456	$28,803	—	5,228,000
State of Colorado	$82,595,077	3,970,971	$20,800	3.0%	1,347,397,000

Source: Colorado Department of Revenue.

While Gunnison County has fewer permanent year-round residents than Delta County, the level of retail sales is higher in Gunnison County than Delta County, at $358.8 million versus $289.2 million respectively. Higher retail sales levels in Gunnison County are primarily due to a substantially larger tourism industry than Delta County. See Figure L-22, Retail Sales Trends (1993-1998).

Businesses within the City of Delta captured over $161 million worth of retail sales in 1998, representing 56% of all retail sales in Delta County. In contrast, the City of Paonia experienced $19.2 million in retail sales and the City of Hotchkiss captured another $20.7 million. These two jurisdictions together account for less than 14% of all retail sales in Delta County.

As noted, Gunnison County generates a higher level of retail sales than does Delta County. Almost 46% of Gunnison County retail sales are generated within the City of Gunnison. Together, Delta County and Gunnison County accounted for over $648 million in retail sales in 1998. This sales volume represents less than 1% of all retail sales statewide.

Delta County generates a relatively low level of retail sales activity as compared to its population. In 1998, Delta County generated $10,900 per person in retail sales, approximately one-half the statewide rate and less than one-third of Gunnison County's rate. Highest per capita sales rates were experienced in the City of Delta ($28,800) and Hotchkiss ($22,600).

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In Gunnison County, retail sales data is reported for three jurisdictions. Mount Crested Butte captured the highest per capita amount at nearly $92,200. Although Mount Crested Butte generated just 9% of Gunnison County retail sales, its status as a resort community and tourism draw likely account for its high level of per capita sales. Crested Butte, a nearby resort community, also experiences relatively high per capita retail sales at $45,500.

Crested Butte and Mount Crested Butte have implemented the highest local retail sales tax rate in the secondary study area at 4%. The 3% tax rate in the major retail centers of the cities of Delta and Gunnison equals the statewide rate.

2.7.4 Property Tax

In 1998, over $8.6 million in property taxes were collected in Delta County. Almost 48% came from residential properties, the largest source of property tax revenues. Approximately 18% of property taxes came from agriculturally-owned property while commercial properties represented just under 16%.

About half of the property taxes collected in Delta County went to the Delta County Joint School District. The mill levy rate of $32.52 per $1,000 assessed value generates over $4.2 million in property tax revenues, 49.5% of total Delta County property taxes. The county portion represents 28% of all property taxes assessed countywide, while towns and cities collect a mere 2% of all property taxes levied countywide. See Figure L-23, 1998 Delta County Property Taxes.

In 1998, coal mines represented $5.7 million of Delta County assessed valuation and $31.5 million in Gunnison County for a combined valuation of $37.2 million. The majority of the assessed value is located in Gunnison County's Somerset community. The greatest share of mine-generated property tax revenues went to the Delta County Joint School District which received more than $1.2 million in 1998.[18]

Railroads serving the coal mines within the secondary study area also constitute a significant property tax revenue source. In 1998, their assessed Delta County value totaled $4.1 million.

2.7.5 Severance Tax

In 1998, Colorado coal mines generated over $9.3 million in severance tax revenues, over $3.3 million more than in 1989 but $1.5 million less than the amount generated in 1997. Since 1989, the long term trend in severance taxes paid in Colorado generally has been up, but with significant year-to-year variations. See Figure L-25, State Coal Severance Tax Trends (1989-1998).

While much of the mining within the secondary study area occurs in the Somerset area of Gunnison County, most mine employees live in Delta County. Because much of the mine activity is located outside the communities where mine employees live, Colorado has implemented a severance tax to help communities pay for services provided to mine employees.

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[18] Source of information comes from Delta County Assessor, Gunnison County Assessor's Office, and The Delta County Independent Newspaper, *Coal Mining in the North Fork...An Introduction*, March 4, 1999.

Based on state severance tax records, 278 employees live in Delta County; 95% of all employees who live in the secondary study area. Nearly 47% of employees live in Paonia, which received almost $51,800 in severance taxes in 1998.

Table 9. Severance Tax Distribution by Principality

	1995		1996		1997		1998	
Community	**Emp.**	**Tax**	**Emp.**	**Tax**	**Emp.**	**Tax**	**Emp.**	**Tax**
Delta County	286	$68,055	244	$67,795	273	$118,593	278	$104,293
Cedaredge	1	$237	3	$885	7	$3,004	6	$2,254
Crawford	54	$12,849	28	$7,779	19	$8,156	41	$15,381
Delta	27	$6,424	24	$6,668	23	$9,873	33	$12,380
Hotchkiss	28	$6,662	23	$6,390	32	$13,736	29	$10,879
Orchard City	3	$1,400	1	$277	3	$1,287	9	$3,376
Paonia	144	$34,265	126	$35,009	112	$48,079	138	$51,771
Rest of Delta County	29	$6218	39	$10787	77	$34458	22	$8,252
Gunnison County	20	$4,759	13	$3,612	14	$6,009	16	$6,002
Delta + Gunnison	306	$72,814	257	$71,407	287	$124,602	294	$110,295

Source: The Delta County Independent Newspaper, *Coal Mining in The North Fork....An Introduction*, March 4, 1999.

2.7.6 Federal Royalties

In 1998, coal mines in Delta County also generated $742,400 in federal royalties. Half of this amount was returned to Delta County. The mines in Gunnison County generated over $6.6 million in royalties; Gunnison County received half or $3.3 million.

Colorado also receives Federal Mineral Lease Fees. These are put into a fund called the energy impact grant program and are available to Colorado communities to fund projects ranging from bridges to recreation. Communities apply for these funds and successful projects are selected by the state. Available funds totaled $12 million in 1998.

2.8 Recreation

Delta County is surrounded by the Grand Mesa, Uncompahgre Plateau and the West Elk Mountains. Portions of Gunnison National Forest and Grand Mesa National Forest are located within Delta County. These significant natural amenities, along with wilderness areas and state parks, offer numerous outdoor activities such as hiking, mountain biking, camping, fishing, hunting and other activities.

Delta County also offers several points of interest and festivities. Significant points of interest include Fort Uncompahgre, Delta City's "City of Murals," Pioneer Town in Cedaredge, and West Elk Loop Scenic Byway. The Ute Indians' Council Tree Pow Wow is one of the most renowned festivals in Delta County.

Within the immediate vicinity of the North Fork coal mines, hunting and other dispersed recreation occurs on a relatively limited basis due to lack of developed recreation facilities. There are no developed recreational facilities operated by the BLM or Forest Service on the proposed coal lease tracts and exploration license area associated with this EIS.

Tourism plays a larger role in the Gunnison County economy than in Delta because of mountain oriented resort activity. Gunnison County has several resort communities, Crested Butte being one of them. Gunnison County also has a number of significant natural features such as the West Elk Mountains, Rocky Mountains, Black Canyon, and Curecanti National Recreation Area.

Points of interest include the Mountain Bike Hall of Fame, Crystal Mill, Blue Mesa Lake (the state's largest), Rocky Mountain Biological Lab, and Tincup, an historic mining ghost town.

In 1997, tourists spent nearly $21.4 million in Delta County. Over 43% (or $9.3 million) comes from visitors staying with friends and family in private homes. Another 33% is from visitors who stayed in lodging facilities.

Over $130 million was spent by tourists in the entire secondary study area, 84% captured by Gunnison County. Visitors staying in lodging facilities represent 63% of all travel spending. Tourists staying in vacation homes spent almost $16.0 million (or 12%) in 1997.

Table 10. 1997 Travel Spending by Type of Accommodation ($1,000)

Accommodation Type	Delta	Delta + Gunnison	Colorado
Destination Spending	$21,380	$126,720	$6,873,120
Lodging	$7,020	$81,600	$4,845,360
Private Campgrounds	$2,120	$8,080	$128,310
Public Campgrounds	$380	$7,110	$137,890
Private Home	$9,300	$13,970	$1,201,280
Vacation Home	$2,560	$15,960	$319,250
Pass Through	—	—	$241,030
Air Transportation in County	—	$3,350	$253,970
Total Spending	$21,380	$130,070	$7,127,090

Source: Colorado Tourism Board and the Colorado Travel and Tourism Authority.

In Delta County, the largest share (29%) of travel expenditures is spent at dining establishments. Another 23% is spent on retail items. Less than 15% of expenditures is spent for overnight accommodations.

In the larger secondary study area, travel expenditures are fairly evenly distributed between business types — with the exception of air transportation. Spending for overnight accommodations accounts for the largest share (25%) of total spending. Spending for ground transportation accounted for 14% of total expenditures.

Table 11. 1997 Travel Spending by Type of Business ($1,000)

Business Type	Delta	Delta + Gunnison	Colorado
Destination Spending	$21,390	$126,740	$6,873,110
Accommodations	$3,140	$32,460	$1,879,090
Dining	$6,270	$29,730	$1,802,740
Retail Sales	$4,900	$25,080	$1,248,340
Recreation	$3,210	$21,800	$923,950
Ground Transportation	$3,870	$17,670	$1,018,990
Air Transportation in County	—	$3,350	$253,970
Total Spending	$21,390	$130,090	$7,127,080

Source: Colorado Tourism Board and the Colorado Travel and Tourism Authority.

Travel spending in Delta County generates about 380 jobs, half of which occurs with dining establishments. Average wage in the tourism sector is $10,200; $5,500 less than the average wage for all Delta County workers.

Approximately 1,920 jobs are supported by travel spending in the entire secondary study area. A significant share of the tourism job base (41%) is associated with dining establishments.

Overnight stay facilities (23%) and recreation facilities (21%) employ another 44% of tourist sector workers. Average wage in the tourism sector is $14,800, higher than Delta County but $2,300 less than the average wage for all workers in the entire secondary study area.

Table 12. Employment Generated by Travel Spending (1997)

Business Type	Delta	Delta + Gunnison	Colorado
Accommodations	70	450	32,090
Dining	190	780	47,400
Retail Sales	30	160	8,080
Recreation	70	410	17,910
Ground Transportation	20	90	4,760
Air Transportation in County	—	30	2,080
Total Employment	380	1,920	112,320
Average Wage	$10,200	$14,800	$13,700

Source: Colorado Tourism Board and the Colorado Travel and Tourism Authority.

In 1997, travel spending generated almost $1.2 million in tax revenues in Delta County. Throughout the entire secondary study area, nearly $6.8 million of tax revenues are generated. The majority of tourism related taxes generated statewide are collected by Colorado's local communities.

Table 13. 1997 Tax Revenues Generated by Travel Spending ($1,000)

Taxes Generated	Delta	Delta + Gunnison	Colorado
Local Taxes	$740	$4,040	$221,300
State Taxes	$420	$2,710	$166,880
Total Tax Receipts	$1,160	$6,750	$388,180

Source: Colorado Tourism Board and the Colorado Travel and Tourism Authority.

2.9 Social Values

The social values of a community reflects the complex interaction of local customs, lifestyles and norms. More than one set of values may be present in a community at a time, as different groupings of people may share certain values in common — but different from others in the community. And values can change over time — whether as the result of changing preferences by existing residents or with the combined forces of in-migration and out-migration.

People often prefer to gravitate to friends, social organizations and communities that share similar cultural backgrounds, needs, behavior patterns, and social perspectives. Households tend to live in areas that offer lifestyles and social values similar to their own. This is particularly true in non-metropolitan or rural communities which traditionally have been less diverse than their urban counterparts. However, even relatively homogenous rural communities are becoming more diverse with in-migrants who may bring different social values and expectations for their adopted community.

An area's social makeup often remains reasonably stable over time. Changes may occur incrementally over a long period of time. A community's stability is derived from its fixed features; housing mix, transportation, schools, job base, and spiritual organization.

Changes usually occur due to transitions in a household's lifestage such as leaving home, "emptying the nest," job relocation, or retirement. In some communities, changes become great or abrupt enough that economic or social conditions become incompatible with a particular household's lifestyle or economic needs. This may prompt a household to relocate to another area with residents who share similar lifestyles, social values or better economic opportunity.

An evaluation of social values may utilize both quantitative as well as sources of information.

The social values information considered in this assessment is based on data compiled by Claritas, Inc. Specializing in natural demographics, this research firm classifies households into 15 social groups using U.S. Census data and consumer data. Information used includes household composition, mobility, ethnicity, social rank, urbanization, and housing data.

Although fifteen major social groups have been identified nationwide, just three are identified by Claritas' analysis as having a significant presence in Delta County.[17] Each of these groups represents a distinctive type of lifestyle, consumer and social behavior.

According to Claritas, rustic living households comprise the greatest proportion (approximately 60%) of Delta County households. These residents tend to have attained a high school education, have low to lower-middle incomes, live in relatively isolated low cost rural areas, and are often older singles or larger yet relatively lower-income families. They often make their living from the land, perhaps from agriculture, mining or construction. The Delta County proportion of rustic living households is six times greater than their proportion in the U.S. as a whole.

Heartlanders make up a second important component (almost 35%) of Delta County's population mix. Delta County heartlanders tend to be older residents with lower middle incomes. They may be couples or part of large, multi-generational families who live in relatively lower-cost areas. Heartlanders are characterized by Claritas as white or Hispanic, with some college education, who fiercely value their independence. Heartlanders are represented nine times more often in Delta County than in the U.S. as a whole.

Besides a high concentration of rustic living and heartlander households, the secondary study area also is well-represented by a third social group, country families. This segment comprises approximately 5% of Delta County households. Their midscale affluence is derived in large measure from the relatively low cost of living available in Delta and Gunnison Counties. Demographically, this lifestyle segment is primarily comprised of homeowning married couples with children who tend to work in industrial or agrarian occupations and whose roots are in farming. Country families are found slightly more often in Delta County than in the U.S. as a whole.

The larger seven-county Central Western Slope region tends to have a greater diversity of social. The region is distributed between *second city center, second city blues* and *working town* households as well as rustic living, heartlander, and country family households. Rustic living families comprise approximately 17% of Central Western Slope households, with heartlanders and country families comprising 14% and 12% respectively.

Second city center households comprise just over 15% of households in the Central Western Slope. They are a highly diverse set of middle class individuals and families. They range from older white-collar married couples with grown children, to aging blue-collar empty nesters, to young blue-collar starter families.

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[17] Claritas, Inc., June, 1999.

The region's "second city blues" (almost 15% of Central Western Slope households) tend to have lower middle incomes and are a mix of working age and retired households. Working age individuals tend to have relatively low or entry-level white-collar occupations such as sales and technical positions. Some are young singles just starting a career, while others are ethnic (often Hispanic) families working in service and labor occupations.

Central Western Slope working town households (11%) are predominantly white, blue-collar families. Many are retired seniors and tend to be lower middle income couples or poor singles. A few are lower middle income, blue-collar, ethnic (often Hispanic) families.

Following just behind the second city blues is the grouping labeled by Claritas as "landed gentry." With 9% of the Central Western Slope's population, this grouping is characterized by predominately affluent, well educated, older white executives with families.

Some social groups that are well represented in Colorado have virtually no presence on the Central Western Slope including Delta and Gunnison Counties. Examples are "elite suburbs," "urban uptown," "the affluentials," "inner suburbs," "urban midscale," and "urban cores."

Table 14. Lifestyles of Study Area Households (1998)

	Urban Class*	Social Group**	Delta County	Delta +Gunnison	Central Western Slope	State of Colorado
High	S1	Elite Suburbs	0.0%	0.0%	0.0%	3.9%
Degree of Affluence	U1	Urban Uptown	0.0%	0.0%	0.0%	10.0%
	C1	2nd City Society	0.0%	0.0%	1.9%	3.1%
	T1	Landed Gentry	0.0%	0.0%	9.0%	6.7%
	S2	The Affluentials	0.0%	0.0%	0.0%	5.8%
	S3	Inner Suburbs	0.0%	0.0%	0.0%	10.4%
	U2	Urban Midscale	0.0%	0.0%	0.0%	11.5%
	C2	2nd City Center	0.0%	7.2%	15.3%	5.1%
	T2	Exurban Blues	0.0%	0.0%	5.2%	6.3%
	R1	Country Families	5.1%	15.0%	11.6%	7.1%
	U3	Urban Cores	0.0%	0.0%	0.0%	9.8%
	C3	2nd City Blues	0.0%	0.0%	14.9%	7.7%
	T3	Working Towns	0.0%	0.0%	11.2%	3.3%
	R2	Heartlanders	34.5%	26.8%	14.2%	4.0%
Low	R3	Rustic Living	60.4%	50.9%	16.7%	5.3%
		All Social Groups	100.0%	100.0%	100.0%	100.0%

Note: * U=Urban, C=Second City, S=Suburban, T=Town, and R=Rural.

** Social Group names are registered trademarks of Claritas, Inc.

Source: Claritas, Inc.

In all three study areas evaluated (Delta County, Delta and Gunnison Counties, and the Central Western Slope), the most-represented social groups tend to be mid to lower income blue collar retirees or large families. *Rustic living, heartlander,* and *country families* all enjoy a relatively low cost of living, with high proportions of residents involved in occupations linked directly or indirectly to Colorado's natural resources.

The larger Central Western Slope region attracts a more affluent population due to its quality of life attributes. These households, although growing, do not yet represent the majority share of the population.

Several overall observations regarding social values of the Delta County rural communities most directly connected to current and potential future mining activities include:

- North Fork communities along the Gunnison River have a long history with coal mining extending back to the late 1800s; however, like much of the American West, the primary study area of Delta County is in transition both economically and culturally. Local communities are becoming more diversified with less dependence on coal mining as a source of income but continued economic benefits from the relatively high-wage jobs.
- Delta County has not yet experienced the rapid in-migration occurring elsewhere in counties of Colorado's Central Western Slope region; however, there is evidence of growing difference in social values of newcomers versus long-time residents. It is generally believed that newer residents are less supportive of traditional rural area natural resource activities including ranching, farming and mining.
- In Delta County, over 60% of households are identified with demographic and lifestyle characteristics of "rustic living." These households tend to come from a tradition and/or remain actively involved in making a living from the land — including agriculture, mining and construction. Households who fit in this "rustic living" category comprise only 17% of Central Western Slope and 5% of all Colorado households, and are therefore much less likely to represent in-migrants to Delta County.
- A number of primary study area residents tend to value the economic opportunity represented by North Fork mining activity. Expanded coal mining also raises concerns of potential negative lifestyle effects such as train noise/crossing blockage, to effects of future temporary or future closures on mine workers, their families and affected communities.
- Whether or not coal mining is viewed as having a positive or negative effect on quality of life depends on the values that receive greatest emphasis from different residents of the North Fork region. Those who place greater emphasis on the economic stimulus and continued job opportunity presented by ongoing coal operations tend to be supportive of continued or expanded coal operations. Those who chose to reside in the area to leave behind the hustle, bustle, noise and pollution of urban living and modern industrial society raise questions or are less favorable to ongoing or expanded North Fork coal mine operations.[18]

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[18] Section 9.0 of the *North Fork Coal EIS — Scoping Document* contains a more complete discussion of quality of life issues as part of the "Synopsis of Public Scoping Comments."

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2.10 Land Ownership and Values

An estimated 56% of Delta County land is in public ownership with another 37% in agricultural use. Only 7% of all land is in non-agricultural private ownership.

As of 1998, total assessed value in Delta County is $167.1 million. Residential properties (at 36%) represent the largest proportion of assessed value. Agricultural land accounts for 14%, with about half the assessed value represented by residential structures. Commercial properties represent only 12% of total assessed Delta County value and industrial uses accounts for less than 1%.

Ten percent of the assessed value in Delta County is comprised of public utility properties (state assessed). Together, public utilities in Delta County account for over $16 million in assessed value. Electric companies make up $5.0 million, telecommunications firms represent another $4.7 million and railroad companies account for $3.9 million. The remaining nearly $2.0 million is owned by gas pipeline companies, private car companies and airline companies.

Over $36.8 million of property representing 22% of all assessed value in Delta County is exempt from property taxes. Exempt properties are primarily in public ownership, such as forest lands, wildlife areas and property owned by governmental jurisdictions. See Figure L-25, Delta County Assessed Values (1998).

Only 4% of Delta County's tax assessed valuation consists of natural resource-related properties. These include mine properties.

3.0 SOCIOECONOMIC EFFECTS

This section discusses the socioeconomic effects of a No-Action Alternative and three Action Alternatives.[19] The assessment of socioeconomic effects used a variety of information. This includes information from the IMPLAN model,[20] interviews with local government officials and mine representatives, data from the U.S. Bureau o Economic Analysis, and information from the Colorado State Department of Local Affairs.

The assessment of socioeconomic effects considers the impact of each alternative on the study area in terms of changes in employment, income, housing, population, school enrollment, other community and public services, recreation, social values, land ownership/values and fiscal conditions. For Alternatives B, C and D, four types of impacts are evaluated:

- **Direct Effects:** The effects caused by either leasing or not leasing, and the effects of granting or denying the exploration license. These effects include the additional employees hired as a result of additional mine production, additional goods and services purchased by the mines from local businesses, additional mine worker household expenditures, and additional fiscal revenues and expenses incurred as a result of the alternatives.

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[19] See Chapter 2 of the EIS for a description of the alternatives.

[20] IMPLAN is an economic model providing information that identifies the relationships between multiple economic sectors at the county level. The model was developed for the Forest Service and draws on a national database from the U.S. Bureau of Economic Analysis and provides data for 528 economic sectors. The state of Colorado also has an economic impact model called RIMS; this model only provides information for 38 aggregated industries by region. The RIMS model places Delta County in one region and Gunnison in the other region.

- **Indirect Effects:** These effects present the additional (or ripple) effects associated with the alternatives. These represent both indirect and induced impacts. Indirect impacts are the effects to so-called backward linked industries (e.g., local firms providing goods and services to the mines. Induced impacts are the effects of household expenditures that could result from the alternatives.
- **Total Effects:** These effects are the combination of direct and indirect effects.
- **Cumulative Effects:** These effects include the broader socioeconomic effects on the larger seven-county central western slope area.[21] These effects are more removed in time and geography from direct and indirect effects, but are reasonably foreseeable.

Direct and indirect socioeconomic impacts are evaluated both Delta and Gunnison Counties. Fiscal effects are evaluated in terms of direct consequences, as indirect effects are less readily quantified. Cumulative impacts are discussed primarily in the context of the larger seven-county tertiary study area.

Due to the nature of the local coal mining industry, underlying technological changes, and relative low levels of added employment needed for longwall mining as compared to room and pillar mining for projected future tonages, Type II Income multipliers were used in assessing the economic impacts for each alternative. The Type II income multiplier is used because none of the action alternatives are anticipated to create or draw additional people to the area. These multipliers also assume that increases in coal production under any of the action alternatives would produce greater income (or wealth), driving associated changes in other industries in Delta and Gunnison Counties.

3.1 Alternative Assumptions

The main socioeconomic difference between the alternatives relates to the amount of coal production assumed to occur. Under the No-Action Alternative (Alternative A), lease agreements would not be issued for the Iron Point and Elk Creek tracts. Instead, remaining coal reserves, at the Bowie No. 2 and Oxbow operations would be completely mined out, and then mining operations are assumed to cease. The Bowie No. 2 Mine is estimated to have 1.5 years of reserves in the D coal seam. Oxbow has an estimated life of approximate 4 years with a continued annual extraction rate of four million tons. Oxbow plans to complete mining at the Sanborn Creek Mine, then move to develop the Elk Creek portal and mine coal reserves from their fee (private) land.

Under Alternative B, approximately 24 million tons of coal reserves would be mined from the Iron Point Coal Lease Tract and 21 million tons from the Elk Creek Coal Lease Tract. Both lease tracts would use longwall technology for coal extraction. It is estimated that the Iron Point reserves would be extracted at a rate of five million tons per year. The production rate would be

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[21] These broader effects go beyond direct and indirect activity and are discussed in a qualitative manner.

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at four million tons per year for the Elk Creek coal tract. These reserves would provide for approximately five years of mining at both the Iron Point and Elk Creek Coal Lease Tracts.

With Alternative C and, approximately 39 million tons of coal reserves would be available for mining at the Iron Point Tract and 23 million tons of reserves at the Elk Creek Tract. As with Alternative B, both mines would utilize longwall technology at similar annual extraction rates, but the higher amount of total reserves made available would result in longer life of the mines. The Iron Point Tract would be in operation for a time period estimated at about eight years; the Elk Creek Tract would be in operation for just under six years.

Additional capital expenditures are anticipated for coal extraction under any of the Action Alternatives (B, C and D). Identified capital expenditures anticipated for the Iron Point Coal Lease Tract include longwall equipment, new conveyor belt and upgrade of coal handling facilities and stockpiling, and ventilation. The Elk Creek Coal Lease Tract would be accessed through mine entries constructed on private surface (Elk Creek Portal). It is assumed for the analysis that existing longwall equipment at the Sanborn Creek Mine would be used for coal extraction from the Elk Creek Tract. The identified capital expenditures for both leases total an estimated $31 million. A portion of these capital expenditures are anticipated to occur within the local two-county area. Together, only 6% of the anticipated capital expenditures would be made in the local study area.[22]

For the Elk Creek Coal Lease Tract, it is anticipated that 30 to 40 construction workers would be needed to set up extraction activities. For this impact analysis, an average of 35 construction workers is applied. Construction is not anticipated to last more than one year; therefore, any socioeconomic effects would be short-lived.

Due to the region's established coal mining industry and data that identifies an existing base of construction workers, this analysis assumes that any construction workers needed are already living in the local study area. Therefore, there should be no need to attract new workers into the two-county study area. With no anticipation of additional mine workers needed, population, housing and school enrollments should remain unaffected by construction-related activity.[23]

Annual purchases to support administrative and mine operational needs would be made under any of the action alternatives. Combined annual purchases for any mining from the Iron Point and Elk Creek Coal Lease Tracts are estimated at $49 million. It is anticipated that 20% of these annual operating purchases annually would be made within the local study area.

Under any of the action alternatives (Alternatives B, C and D), operations employment would not significantly increase above current conditions. Bowie plans to increase their work force from 157 (room and pillar mining) to 168 (longwall). Oxbow employment would remain constant at 215 employees. With no anticipation of significant additional mine workers needed for the lease tracts, population, housing and school enrollments for the action alternatives should be unaffected compared to current conditions.

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[22] Additional expenditures could be anticipated for the tertiary study area, particularly to mining suppliers located in or near Grand Junction.

[23] These effects are discussed more in-depth under the alternative sections of this report.

According to data from the U.S. Bureau of Economic Analysis (BEA), construction workers of all types in the local study area earn, on average, $22,100 per year. However, BEA data does not specifically identify construction workers at mining operations. They are anticipated to earn more than the average construction work in the study area. Therefore, data from the IMPLAN model was used which identified an average wage for mining construction workers at $24,600.

IMPLAN model data was also used rather than BEA data to estimate the average wage of mine workers, contract operators, and reclamation personnel. BEA estimates that workers in the mining industry earned $53,300 on average compared to an annual estimated wage of $59,500 per employee with IMPLAN.[24]

Table 15. Mine Development Assumptions for Each Alternative

	Iron Point Coal Lease Tract				Elk Creek Coal Lease Tract			
Assumption	**Alt. A ***	**Alt. B**	**Alt. C**	**Alt. D**	**Alt. A**	**Alt. B**	**Alt. C**	**Alt. D**
Years of Activity:								
Construction	—	1.0	1.0	1.0	—	1.0	1.0	1.0
Life of Mine	1.5	[illegible]	7.8	7.8	3.6	5.3	5.8	5.8
Reclamation	—	1.5	1.5	1.5	—	1.0	1.0	1.0
Mine Production (millions of tons):								
Total New Reserves	5.5	24.0	39.0	39.0	14.5	21.0	23.0	23.0
Annual Extraction	-3.7	5.0	5.0	5.0	-4.0	4.0	4.0	4.0
Employment:								
Construction	—	—	—	—	—	35	35	35
Mine Workers (FTE)	-168	168	168	168	-190	190	190	190
Contract Operators	—	—	—	—	-25	25	25	25
Reclamation	—	35	35	35	—	43	43	43
% Live in Local Study Area	89%	89%	89%	89%	94%	94%	94%	94%
Average Annual Wage:								
Construction	$24,600	$24,600	$24,600	$24,600	$24,600	$24,600	$24,600	$24,600
Mine Workers, Contract Operators, Reclamation	$59,500	$59,500	$59,500	$59,500	$59,500	$59,500	$59,500	$59,500

Note: Figures for Alternative A reflect activity at the Bowie #2 and Oxbow (Sanborn) mines respectively.

Source: E.D. Hovee & Company, August 1999.

3.2 Effects of the No-Action Alternative

Socioeconomic effects of the No-Action Alternative (Alternative A) would occur due to a reduction in coal mine activities within the local study area. Under the No-Action Alternative, mining of reserves at existing mines would continue at current extraction rates until reserves are.

To be conservative, impacts associated with a No-Action Alternative are expressed as maximum potential effects on an annual basis after cessation of existing operations at the Bowie and Oxbow sites.

3.2.1 Employment and Income

Direct Effects. An estimated 168 workers would be employed for longwall mining at the Bowie No. 2 Mine. Under the No-Action Alternative, these employees would likely be laid off when

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[24] BEA data identified 631 mine workers within the local study area (as of 1996), which includes workers in all mining activities. IMPLAN estimates that there are 548 coal mine workers in the local study area as of 1996.

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existing coal reserves are depleted. Each mine worker earns, on average, an estimated $59,500 per year, translating into an annual payroll of nearly $10 million. At current production rates, the initial effects of these losses would not be experienced for another 18 months.

The Sanborn Creek Mine (Oxbow) employs 215 mine workers and contractors. Cessation of mine operations would translate to a loss of $12.8 million dollars in annual payroll, based an annual average wage estimated at $59,500 per worker.

Table 16. Forecast Annual Employment and Payroll Direct Effects (Alternative A — No-Action)

Operations Phase	Iron Point	Elk Creek	Combined*	Comments
Employment (average)	-168	-215	-383	Per alternative leasing agreements as discussed in Chapter 2 of this EIS.
Wages Paid per Employee	$59,500	$59,500	$59,500	As per 1996 MIG's IMPLAN database.
Estimated Payroll	-$9,996,000	-$12,792,500	-$22,788,500	

*Note: Combined effects show maximum potential loss in activity when Bowie No. 2 and Oxbow mines cease operations.

Source: E.D. Hovee & Company, based on information provided by proponents and IMPLAN data, August 1999.

Combined effects of discontinuing operations at the existing Bowie and Oxbow mines would represent loss of 383 jobs. Averaging $59,500 in annual salary, total lost annual payroll would approximate $22.8 million.

Indirect Effects. Using MIG's IMPLAN model, for every mine worker in the local study area, an estimated 1.7 workers are supported by mining operations and mine worker household purchases. With the Bowie No. 2 Mine, approximately 285 local non-mine workers are indirectly supported by current operations. The Oxbow operation is estimated to indirectly support another 365 local non-mine workers. If both mines were to close, then an estimated 650 locally-supported non-mine jobs in Delta and Gunnison counties could potentially be negatively affected (i.e., laid off, work time reduced, etc.) due to the cessation of mining activity.

IMPLAN estimates that for every $1.00 earned by mine workers, another $0.52 in income is supported in the local study area. This calculation means that the Bowie No. 2 Mine currently support up to $5.2 million in additional local income, while the Oxbow operation supports another $6.7 million in additional study area income. Closure of both mines could lead to a reduction of $11.9 million in non-mine related income throughout the affected study area.

Any losses of indirect study area employment or income would coincide with changes in study area mining activity. This is not anticipated to occur for at least 18 months, when it is assumed for this analysis that the Bowie No. 2 Mine would cease mining activity, followed by anticipated closure of the Sanborn mine two to three years later.

Table 17. **Forecast Annual Employment and Payroll Indirect Effects (Alternative A — No-Action)**

Operations Phase	Iron Point	Elk Creek	Combined*	Comments
Employment (average)	-285	-365	-650	A multiplier of 1.7 was used as derived from MIG's 1996 IMPLAN model.
Wages Paid per Employee	$18,200	$18,200	$18,200	As per 1996 MIG's IMPLAN database.
Estimated Payroll	-$5,197,900	-$6,652,100	-$11,850,000	A multiplier of 0.52 was used as derived from MIG's 1996 IMPLAN model.

*Note: Combined effects show maximum potential loss of activity when Bowie #2 and Sanborn mines cease operations..

Source: E.D. Hovee & Company, August 1999.

Total Effects. Total direct and indirect mine closure effects could represent a loss of up to 1,033 jobs and over $34.6 million in annual payroll.

Table 18. **Forecast Annual Employment and Payroll Total Effects (Alternative A — No-Action)**

Operations Phase	Iron Point	Elk Creek	Combined*	Comments
Employment (average)	-453	-580	-1,033	Sum of direct & indirect effects.
Wages Paid per Employee	$33,500	$33,500	$33,500	
Estimated Payroll	-$15,193,900	-$19,444,600	-$34,638,500	Sum of direct & indirect effects.

*Note: Combined effects show maximum potential loss of activity when Bowie #2 and Sanborn mines cease operations.

Source: E.D. Hovee & Company, August 1999.

If these jobs were not replaced, and if workers chose to remain in the two-county study area, the unemployment rate for Delta and Gunnison Counties combined could increase from the current rate of just over 5% to nearly 12%, at least short-term. The projected losses of over $34.6 million in annual payroll would not be fully realized as these workers would be eligible for unemployment payments, further increasing the percentage of local study area income derived from transfer payments.[25]

Paonia and Hotchkiss could expect to experience the effects most directly, as 56% to 67% of mine workers live in that area. The city of Delta also would be affected because local mine-related expenditures are largely made within the city.

Cumulative Effects. If affected workers left the two-county study area, a substantial number likely would choose to remain within the broader seven-county Central Western Slope area, as considerable inter-county migration occurs within the broader study area.[26] This might put pressure on other central western slope communities to create jobs for the workers displaced from employment in Delta and Gunnison counties, as well as provide community services.

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[25] The unemployment payments that these workers would receive cannot be determined because these payments are usually determined on a case-by-case basis.

[26] According to IRS migration data for 1996–1997, almost 30% of residents leaving Delta County moved to other central western slope counties. Approximately 80% moved to neighboring Mesa and Montrose Counties.

3.2.2 Housing, Population and School Enrollment

For purposes of this analysis, it was assumed that each affected worker represents a separate household within the local study area. Demographic assumptions utilized to estimate population and school-age children are that household size avarages 2.38 and school-age children (age 5-17) constitute 17.4% of the population.

Direct Effects. Of the 168 mine workers employed at Bowie No. 2 Mine, 150 are estimated to live within the local study area, representing 360 residents and 60 school-aged children. The 200 of 215 workers at the Oxbow operation that live in the local study area account for almost 480 local area residents with over 80 school aged children. If both mines ceased operations, more than 800 residents (145 of school age) would be directly affected. Whether these children would remain enrolled in local schools would depend on whether parents choose to relocate elsewhere to find employment or remain in the local study area.

Table 19. Forecast Housing, Population and School Enrollment Direct Effects (Alternative A — No-Action)

Operations Phase	Iron Point	Elk Creek	Combined*	Comments
# of Households	-150	-200	-350	Each local worker is assumed to represent one separate household.
Estimated Population	-357	-476	-833	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	-62	-83	-145	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.

*Note: Combined effects show maximum potential loss of activity when Bowie #2 and Sanborn mines cease operations.

Source: E.D. Hovee & Company, August 1999.

Indirect Effects. Closure of the Bowie No. 2 Mine would indirectly affect approximately 680 residents and almost 120 school-age children. Closure of the Oxbow operations could indirectly affect almost 870 residents and 150 school-age children in the two-county study area. Over 1,500 local study area residents could be indirectly impacted if both mines were to close, which include almost 270 school-age children.

Table 20. Forecast Housing, Population and School Enrollment Indirect Effects (Alternative A — No-Action)

Phase of Work	Iron Point	Elk Creek	Combined*	Comments
Operations Phase:				
# of Households	-285	-365	[illegible]	Each worker is assumed to represent one separate household.
Estimated Population	-678	-869	-1,547	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	-118	-151	-269	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.

*Note: Combined effects show maximum potential loss of activity when Bowie #2 and Sanborn mines cease operations.

Source: E.D. Hovee & Company, August 1999.

Total Effects. Closure of the Bowie No. 2 Mine could affect a combined direct and indirect population of almost 1,035 people. Closure of the Oxbow operations would affect an estimated 1,345 residents. Combined, these two mine closures could affect nearly 2,380 residents living in the local study area, over 410 of them school-aged children.

Table 21. Forecast Housing, Population and School Enrollment Total Effects (Alternative A — No-Action)

Operations Phase	Iron Point	Elk Creek	Combined*	Comments
# of Households	-435	-565	-1,000	Each worker is assumed to represent one separate household.
Estimated Population	-1,035	-1,345	-2,380	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	-180	-234	-414	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.

*Note: Combined effects show maximum potential loss of activity when Bowie #2 and Sanborn mines cease operations.

Source: E.D. Hovee & Company, August 1999.

If a significant portion of residents choose to migrate outside the two-county study area, the local housing market could experience at least a temporary downturn (e.g. decline in property values) because a large number of homes might come onto the market simultaneously, potentially driving down prices. Local schools also would be affected, as a substantial portion of

Cumulative Effects. With the No-Action Alternative, a significant portion of residents could be expected to relocate to other communities within the Central Western Slope Region. The number of low-income families living in the greater Central Western Slope area could also increase.

3.2.3 Other Community and Public Services

Beyond schools, a variety of other community and public services likely would be affected under the No-Action Alternative when mining operations are closed. Services may be affected due to changed service demands and/or reduce ability to fund required services.

Direct Effects. Over a short-term period of job loss (with mine cessation), needs for some community and public services could be expected to increase. Examples are law enforcement and social services. Over a longer term period, these effects may be diminished as displaced mine workers obtain alternative employment and/or relocate from the study area.

Indirect Effects. The economic multiplier relationship of direct to indirect employment could create further service demands from dislocation of workers currently supported by mining activity. A second type of indirect effect would result from reduced local tax revenues as local incomes decline and/or property values decline, whether temporarily or longer term.

Declining revenues would make it more difficult to fund community and public services at a time when they are more urgently needed. However, as with the direct effects, indirect effects might diminish over time as displaced workers find alternative employment and/or relocate from the primary/secondary study area.

Total Effects. Community and public service providers would be affected by this combination of direct and indirect effects. If not offset by alternative sources of revenue, the level of service available from existing providers would decline.

Cumulative Effects. If alternative employment were not available to displaced mine workers, some households could be expected to relocate to other communities in the tertiary central western slope area. This could increase demands for community and public service providers in the communities affected.

3.2.4 Fiscal Effects

The state of Colorado and local jurisdictions in Delta and Gunnison counties currently receive an estimated $11.4 million in combined annual tax revenue related to the Bowie and Oxbow operations and mine-related employees. Approximately 52% of this revenue is received by (and stays with) the state of Colorado; 48% is collected by or passes through to local jurisdictions in the secondary study area of Delta and Gunnison counties.

With cessation of mine operations, payment of tax revenues attributable directly to mine operations ($9.7 annually) would cease. A portion of the remaining $1.7 million in taxes attributable to mine workers might continue to be received, depending on factors such as ongoing employment for reclamation, unemployment payments while workers are displaced, eventual ability to obtain re-employment, and need for relocation.

Fiscal consequences beyond direct effects are difficult to quantify due to the unpredictable outcome of decisions made by displaced mine workers.

3.2.5 Recreation, Social Values, Land Ownership and Values

Differing effects may be experience, based on such factors as the perspective of a particular individual or social group, geographic area considered, and time elapsed from implementation of a No-Action Alternative.

Effects that might be expected are varied, potentially including:

- Reduced recreation from those displaced directly or indirectly by mining cessation, perhaps offset in part by those using recreation lands for hunting or fishing activity.
- Diminution in income levels and quality of life for those displaced directly or indirectly from mine closure.
- Potential enhancements in quality of life for some residents whose economic livelihood is not related in any substantial way to mining activity; a specific example would be reduced train activity and associated noise and crossing blockages.
- For at least the short-term, property values might decline if a substantial proportion of displaced workers decided to place their homes on the market and relocate from the area. Changes in property ownership would be related to existing owners who decided to relocate.

Over time, cessation of mining would continue the trend toward in-migration of persons less dependent on traditional natural resource activities throughout Colorado's central western slope region. Rustic living households will transition to other economic and lifestyle social groupings.

3.3 Effects Common to All Action Alternatives

The primary socioeconomic difference between the action alternatives is related to the amount of coal reserves that would be available for mine extraction. Neither Bowie or Oxbow anticipates increasing employment levels significantly above what is already currently planned for their existing operations; consequently, there should be no major socioeconomic impacts (e.g. additional employment levels, income, associated demographic characteristics, population, housing, or public school enrollments) anticipated under any of the action alternatives.

Leasing of federal coal is competitive. However, for purposes of this analysis, even if the applicants (Bowie and Oxbow) were not successful at securing the leases, the same workforce is assumed to be needed to the successful bidder for mining operations.

Because no significant increases or decreases in mine employment are anticipated, socioeconomic effects are discussed in terms of continuing support at the Bowie and Oxbow sites. This means the socioeconomic effects discussed in this section should be viewed as a continuation of existing effects and not as new impacts to the local study area. The effects common to all action alternatives are discussed below.

3.3.1 Employment and Income

Direct Effects. The Elk Creek Coal Lease Tract anticipates the need for 35 construction workers for the first 12 months of mine extraction. These workers are anticipated to earn $24,600, producing $861,000 in estimated payroll. It is assumed that no added construction workers are needed for the Iron Point Coal Lease Tract.

During the period of mine operations, it is assumed that 168 mine workers would be needed for the Iron Point Tract and 215 workers would be employed for the Elk Creek Tract. These workers are anticipated to earn an average $59,500 annually, yielding an estimated Iron Point payroll at $10.0 million annually and payroll of almost $12.8 million for the Elk Creek Tract. Total operations employment associated with the Iron Point and Elk Creek Coal Lease Tracts combined is 383 jobs with ongoing payroll of $22.8 million annually while both tracts are operational.

For reclamation and project decommissioning, it is estimated 30 to 40 workers would be needed for the Iron Point Tract. An average of 35 workers was used to assess the reclamation phase socioeconomic effects. It is estimated that 40 to 45 workers (including 5-10 mine employees and 30-40 contract workers) would be needed for the Elk Creek Tract; an average of 43 reclamation workers was assumed for this analysis. Reclamation is estimated to take 1.5 years for the Iron Point Tract and related facilities, while approximately one year would be required for reclamation work at the Elk Creek Tract and associated facilities.

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Table 22. Forecast Annual Employment and Payroll Direct Effects

Phase of Work	Iron Point (B-D)	Elk Creek (B-D)	Iron Point & Elk Creek Combined (B-D)*
Construction Phase:			
Employment (average)	—	35	35
Wages Paid per Employee	—	$24,600	$24,600
Estimated Payroll	—	$861,000	$861,000
Operations Phase:			
Employment (average)	168	215	383
Wages Paid per Employee	$59,500	$59,500	$59,500
Estimated Payroll	$9,996,000	$12,792,500	$22,788,500
Reclamation Phase:			
Employment (average)	35	43	78
Wages Paid per Employee	$59,500	$59,500	$59,500
Estimated Payroll	$2,082,500	$2,558,500	$4,641,000

*Note: Combined effects show maximum potential activity when operations at Iron Point and Elk Creek tracts are underway at the same time. These illustrate the amount of activity expected to *continue* under the action alternatives and are *not* in addition to what is currently occurring.

Source: E.D. Hovee & Company, based on information provided by mine operators and IMPLAN data, August 1999.

Indirect Effects. Construction activities at the Elk Creek lease tract are estimated to support up to 0.33 workers in the local economy per construction worker employed at this facility.[27] Construction mining activities also support slightly more than $0.20 in indirect wages per dollar paid to construction workers at the Elk Creek facility.[28] This translates into a total of ten workers being supported in the local economy, yielding a payroll of $180,800.

It is estimated that every local study area coal mine operations or reclamation employee in the local study area support another 1.7 local workers. These mine workers also support another $0.50 of non-mine related income in the local study area per $1.00 paid to the mine workers.

The 168 workers employed by the Iron Point Coal Lease Tract would support another 285 local workers that earn just under $5.2 million in annual income. The 215 mine workers for the Elk Creek Coal Lease Tract are estimated to support 365 workers, providing just under $6.7 million in annual income to the local economy. Taken together, the Iron Point and Elk Creek Coal Lease Tracts would support an estimated 650 indirect jobs with $11.8 million in annual payroll.

During reclamation, Iron Point Tract is estimated to support 60 workers in the local study area at a combined annual income of $1.1 million.[29] The Elk Creek Tract is estimated to support 75 local workers during the reclamation phase, with a combined annual income of over $1.3 million. An estimated 135 jobs are supported during the reclamation period at both mines, with payroll of up to $2.4 million annually.

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[27] Economic employment multiplier comes from MIG's 1996 IMPLAN model for workers working in the new mineral extraction facilities sector.

[28] Ibid.

[29] Employment and income multipliers used in the operations phase also were used in estimating reclamation socioeconomic effects.

Table 23. Forecast Annual Employment and Payroll Indirect Effects

Phase of Work	Iron Point (B-D)	Elk Creek (B-D)	Iron Point & Elk Creek Combined (B-D)*
Construction Phase:			
Employment (average)	—	10	10
Wages Paid per Employee	—	$18,100	$18,100
Estimated Payroll	—	$180,800	$180,800
Operations Phase:			
Employment (average)	285	365	650
Wages Paid per Employee	$18,200	$18,200	$18,200
Estimated Payroll	$5,197,900	$6,652,100	$11,830,000
Reclamation Phase:			
Employment (average)	60	75	135
Wages Paid per Employee	$18,000	$17,700	$17,900
Estimated Payroll	$1,082,900	$1,330,400	$2,413,300

*Note: Combined effects show maximum potential activity when operations at Iron Point and Elk Creek tracts are underway at the same time. These illustrate the amount of activity expected to *continue* under the action alternatives and are *not* in addition to what is currently occurring.

Source: E.D. Hovee & Company, using IMPLAN multipliers for construction and coal mining activity, August 1999.

Total Effects. During construction associated with the Elk Creek Coal Lease Tract, a total of 45 local workers would be supported over an approximate one-year time frame. It is estimated that just over $1 million in annual income would be generated. During operations, Iron Point Coal Lease Tract would be expected to support more than 450 local workers and income of almost $15.2 million annually in the local study area. The Elk Creek Coal Lease Tract would be estimated to support 580 jobs at an annual local income of over $19.4 million. During periods when mining is occurring on both lease tracts at the same time, the mining activities are estimated to support over 1,000 direct and indirect jobs in the local economy and over $34.6 million in annual local income.

During reclamation, it is estimated that about 95 workers with an annual income of $3.2 million would be required for the Iron Point Coal Lease Tract. Elk Creek is estimated to support nearly 120 workers at an annual income of almost $3.9 million. Combined, these facilities will support over 210 workers and income of nearly $7.1 million annually during reclamation. Iron Point reclamation is anticipated to take 1.5 years, while Elk Creek is estimated to take somewhat less than one year. After reclamation has been completed, ongoing environmental and reclamation monitoring would occur for both facilities.

3.3.2 Housing, Population and School Enrollment

In evaluating the continuing housing, population and school enrollment effects, it has been assumed that each worker represents a separate household within the local study area. Furthermore, because this study area historically has experienced coal mining activity, it is assumed that the workers in question continue to live at their current place of residence for all phases of mining-related activity.[30] Therefore, the development of either facility is not anticipated to attract added labor force (or population) from outside the two-county local study area.

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[30] This assumption is confirmed by payroll data indicating residence locations for current Bowie and Oxbow employees as presented in the affected environment section of this EIS.

Table 24. Forecast Annual Employment and Payroll Total Effects

Phase of Work	Iron Point (B-D)	Elk Creek (B-D)	Iron Point & Elk Creek Combined (B-D)*
Construction Phase:			
Employment (average)	—	45	45
Wages Paid per Employee	—	$23,200	$23,200
Estimated Payroll	—	$1,041,800	$1,041,800
Operations Phase:			
Employment (average)	453	580	1,033
Wages Paid per Employee	$33,500	$33,500	$33,500
Estimated Payroll	$15,193,900	$19,444,600	$34,605,500
Reclamation Phase:			
Employment (average)	95	118	213
Wages Paid per Employee	$33,300	$33,000	$33,000
Estimated Payroll	$3,165,400	$3,888,900	$7,054,300

*Note: Combined effects show maximum potential activity when operations at Iron Point and Elk Creek Tracts are underway at the same time.

Source: E.D. Hovee & Company, using IMPLAN multipliers for construction and coal mining activity, August 1999.

As with Alternative A, the 1997 average household size (2.38 persons per household) for the two-county study area is used to estimate the affected population. The proportion of school age population (17.4%) for the two-county area in 1997 is also applied to estimate affected school enrollments.

As with the employment and income effects, the housing, population, and school enrollment effects are presented as a continuation of existing effects and not as new impacts to the local study area. They are used for illustration purposes to indicate the level of socioeconomic activity that the two new mine facilities would continue to support.

Direct Effects. Construction workers associated with the Elk Creek Tract are estimated to represent 35 households. Based on the local study area's average household size, these households would account for over 80 current residents that are estimated to have 14 school age children between them. Based on IMPLAN data, over 50 workers in the new mineral extraction facility sector were identified as working within the two-county area; therefore, it is assumed that most if not all of these workers already live in the secondary study area.

It is assumed that 150 out of the168 workers to be employed for mining of the iron Point Tract would continue to live within the local study area; they are estimated to represent almost 360 persons with 60 of school age. The 215 workers associated with the Elk Creek Tract are estimated to represent 480 local residents with nearly 80 of school age.[31]

The 35 reclamation workers associated with the Iron Point Tract are anticipated to be workers that were employed during the operational phase and who would remain for reclamation work. These workers would account for a little more than 80 local residents with 14 school age. The 43 mine reclamation workers for the Elk Creek Tract are estimated to represent just over 100 local study area residents with 18 of school age.

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[31] Enrollment figures represent estimated conditions based on characteristics of study area population rather than actual school enrollment associated with mine employees at any particular point in time, whether currently or prospectively.

Table 25. Forecast Housing, Population and School Enrollment Direct Effects

Phase of Work	Iron Point (B-D)	Elk Creek (B-D)	Combined (B-D)*	Comments
Construction Phase:				
# of Households	—	35	35	Each worker is assumed to represent one separate household.
Estimated Population	—	83	83	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	—	14	14	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.
Operations Phase:				
# of Households	150	200	350	Each local worker is assumed to represent one separate household.
Estimated Population	357	476	833	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	62	83	145	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.
Reclamation Phase:				
# of Households	35	43	78	Each worker is assumed to represent one separate household.
Estimated Population	83	102	185	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	14	18	32	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.

*Note: Combined effects show maximum potential activity when operations at Iron Point and Elk Creek tracts are underway at the same time.

Source: E.D. Hovee & Company, using IMPLAN multipliers for construction and coal mining activity, August 1999.

Taken together, an estimated 350 households with 833 residents and 145 school age children are assumed for both the Iron Point and Elk Creek Tracts. This drops to 78 households with 185 residents (32 school age children) during the subsequent period of site reclamation and closure work.

Indirect Effects. The ten local workers supported by construction workers at the Elk Creek are estimated to represent almost 25 existing local residents with four being school age children.

The 285 local workers supported indirectly by Iron Point operations are estimated to represent 680 residents with just under 120 of school age. The Elk Creek operations are estimated to indirectly support 365 local workers; they represent approximately 870 residents with just over 150 estimated to be school age children.

Approximately 60 local workers would be indirectly supported by reclamation activities at Iron Point. They represent over 140 residents with 25 of school age. The 75 workers being indirectly supported in the local area due to Elk Creek reclamation activities are estimated to represent almost 180 residents with approximately 30 of school age.

Table 26. Forecast Housing, Population and School Enrollment Indirect Effects

Phase of Work	Iron Point (B-D)	Elk Creek (B-D)	Combined (B-D)*	Comments
Construction Phase:				
# of Households	—	10	10	Each worker is assumed to represent one separate household.
Estimated Population	—	24	24	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	—	4	4	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.
Operations Phase:				
# of Households	285	365	650	Each worker is assumed to represent one separate household.
Estimated Population	678	869	1,547	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	118	151	269	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17. Represents no net increase over current conditions.
Reclamation Phase:				
# of Households	60	75	135	Each worker is assumed to represent one separate household.
Estimated Population	143	179	322	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	25	31	56	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.

*Note: Combined effects show maximum potential activity when operations at Iron Point and Elk Creek tracts are underway at the same time.

Source: E.D. Hovee & Company, using IMPLAN multipliers for construction and coal mining activity, August 1999.

Together, the two mines would be indirectly support 650 households with close to 1,550 residents and 270 students. During reclamation, this would decline to 135 households, total population of less than 325 and just over 55 students.

Total Effects. During the 12 months of construction associated with the Elk Creek Tract, it is estimated that nearly 110 residents with almost 20 school aged children would be supported by activities related to preparing the facility for operations. Due to the relatively short duration of the construction phase and the assumption that the workers already live in the local study area, the seven-county central western slope area is not expected to be impacted in terms of socioeconomic factors including changes to underlying social values or land ownership/values.

Iron Point operations are estimated to continue to support nearly 1,040 residents with 180 of school age. Elk Creek is anticipated to continue to support 1,350 residents annually and 230 being school-aged children. These effects are anticipated to continue for 5 to 8 years at Iron Point and 5 to 6 years at Elk Creek.

A reduced number of residents would continue to be supported by mine-related activity after mining operations cease during the reclamation phase. At Iron Point, a total of 230 residents, less than 40 of school age, would be supported. At Elk Creek, it is estimated that over 280 residents would be supported during reclamation, nearly 50 of school age.

Table 27. Forecast Housing, Population and School Enrollment Total Effects

Phase of Work	Iron Point (B-D)	Elk Creek (B-D)	Combined (B-D)*	Comments
Construction Phase:				
# of Households	—	45	45	Each worker is assumed to represent one separate household.
Estimated Population	—	107	107	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	—	18	18	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.
Operations Phase:				
# of Households	435	565	1,000	Each local worker is assumed to represent one separate household.
Estimated Population	1,035	1,345	2,380	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	180	234	414	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.
Reclamation Phase:				
# of Households	95	118	213	Each worker is assumed to represent one separate household.
Estimated Population	226	281	507	Assumes the current average 1997 household size of 2.38 persons for the two-county study area.
School Enrollment	39	49	88	Assumed to represent the 1997 percentage (17.4%) of population that is age 5-17.

*Note: Combined effects show maximum potential activity when operations at Iron Point and Elk Creek tracts are underway at the same time.

Source: E.D. Hovee & Company, using IMPLAN multipliers for construction and coal mining activity, August 1999.

During peak operations, the Iron Point and Elk Creek Tracts would support an estimated 1,000 households, translating into 2,380 residents with over 410 school age children. With reclamation, the number of households supported directly and indirectly by these mines drops to just over 210 and 500+ residents with less than 90 school age children.

3.3.3 Other Community and Public Services

During operations, annually recurring effects are expected to be similar for each of the action alternatives (B, C and D). The primary difference is associated with anticipated duration of mine operations, with Alternatives C and D occurring over a longer time period than Alternative B.

During the period of mine operations, effects on community and public service providers generally could be expected to involve little to no change from current conditions. This is because mine operation employment associated with mining of the Iron Point and Elk Creek Coal Lease Tracts would essentially be the same as at the existing Bowie and Oxbow operations. Upon eventual cessation of mine operations, effects would be comparable to those

3.3.4 Recreation, Social Values and Land Ownership

As with Alternative A, differing effects may be experienced with Alternatives B, C and D. For the Action Alternatives, effects may vary depending on such factors as the perspective of a particular individual or social group, geographic area considered, and time elapsed from implementation.

Effects might include:

- Continued recreation opportunity for existing residents and visitors, but with some potential reduced opportunity for recreation on federal lands in the vicinity of the Iron Point and Elk Creek Coal Lease Tracts.
- Maintenance of incomes, quality of life and social values of existing mine workers and other workers or businesses that benefit indirectly from mine-related activity.
- Potential diminution of quality of life and social values for some residents whose economic livelihood is not related in any substantial way to mining activity; a commonly cited example is increase train activity and associated noise and crossing blockage.
- No change in property values or ownerships would be expected due to mine operations over the period of their continuation. Any changes would be attributed to other external market conditions and typical patterns of turnover in real estate ownership.

Alternatives B, C and D would involve continued mining for a period of approximately 5 to 8 years beyond what is expected with Alternative A. It is conceivable that the life of affected North Fork mines could be extended further if operators successfully secure previously unmined coal reserves on private lands or added federal leases.

Continued mining offers opportunity to maintain the social values of primary and secondary study area households that depend on or relate to natural resource-related industries. Delta County, in particular, likely could continue to maintain an economic and lifestyle profile different from that of other central western slope counties in Colorado through the period of ongoing mining activity.

3.4 Multi-Year Socioeconomic

Annual socioeconomic effects under each action alternative are anticipated to produce similar socioeconomic effects on an annual basis. However, because the amount of coal reserves and associated duration of each alternate lease agreement differs between alternatives, multi-year effects are evaluated in order to discuss the total potential impact expected to continue to occur in the local study area. These too are presented for illustrative purposes in order to identify the expected level of socioeconomic activity anticipated to be continually supported over the life of both mines.

Multi-year effects are calculated by estimating the annual effects of each phase of development, multiplying the annual effects by the anticipated duration (i.e. number years) of each phase, and adding the multi-year effects of each phase together. For example, a mine expected to support 10 workers during one year of construction, 100 workers during five years of operations, and 40 workers during three years of reclamation would result in 630 employee years (10 x 1+100 x 5+40 x 3 = 630) of job-related activity. *Note:* Employee effects are expressed in terms of employee years, pay in terms of total income generated over the life of the entire mine activities, and population in terms of person years.

The combined direct and indirect multi-year effects that are anticipated to be continually supported by Alternative B result in over 5,600 employee years, a total cumulative income of $187.9 million, and total estimated 13,000 person years (of population supported).

Table 30. **Multi-Year Employment, Income and Population Total Effects (Alternative B)**

Cumulative Effects	Iron Point	Elk Creek	Combined
Total Employment Years	2,412	3,208	5,620
Multi-Year Payroll	$80,844,220	$107,014,850	$187,859,070
Total Person Years (population)	5,533	7,449	12,982

Source: E.D. Hovee & Company, based on Alternative B reasonably foreseeable scenario, August 1999.

3.4.3 Multi-Year Effects of Alternative C and D

With Alternative C, an estimated 39 million tons of coal would be mined from the Iron Point Coal lease Tract at a rate of five million tons per year. At this rate of production, the life of mining from the Iron Point Tract would be about eight years. It is assumed that development activities for the Iron Point Tract would take no more than 1 year, and after the reserves have been mined, reclamation would proceed, taking approximately 1.5 years.

For Alternative C, an estimated 23 million tons of coal would be mined at a rate of four million tons per year. The life of the mining from the Elk Creek Tract would be less than six years. Once again, construction activities for the Elk Creek Tract are assumed to take approximately 1 months. Reclamation also is estimated at 12 months.

Alternative D anticipates extraction of coal resources and an operating period comparable to that of Alternative C. Consequently, both Alternatives C and D are viewed as having comparable multi-year effects.

With either Alternative C or D, it is estimated that multi-year effects of mining from the Iron Point Tract would continue to produce just under 1,400 employee years and generate a total income of $83.2 million. Total multi-year population effects would result in a population supported of just under 3,000 person years.

It is estimated that multi-year effects of mining from the Elk Creek Tract would continue to produce just over 1,300 employee years and generate a total income of $77 million. Total multi-year population effects would result in just over 2,900 person years.

Table 31. **Multi-Year Employment, Income and Population Direct Effects (Alternatives C and D)**

Direct Effects	Iron Point	Elk Creek	Combined
Total Employment Years	1,398	1,314	2,712
Multi-Year Payroll	$83,175,050	$76,976,375	$160,151,425
Total Person Years (population)	2,992	2,922	5,914

Source: E.D. Hovee & Company, based on Alternative C and D reasonably foreseeable scenario, August 1999.

As with Alternative B, Alternatives C and D would also continue to support multi-year indirect impacts. It is estimated that both facilities combined would have a multi-year effect that would continue to generate close to 4,600 employee years, a total payroll of $83 million, and a residential population base of almost 11,000 person years.

Table 32. Multi-Year Employment, Income and Population Indirect Effects (Alternative C-D)

Indirect Effects	Iron Point	Elk Creek	Combined
Total Employment Years	2,373	2,184	4,557
Multi-Year Payroll	$43,250,870	$39,760,775	$83,011,645
Total Person Years (population)	5,646	5,200	10,846

Source: E.D. Hovee & Company, based on Alternative C and D reasonably foreseeable scenario, August 1999.

The combined direct and indirect multi-year effects could include almost 7,300 employee years, a total cumulative income of $243.2 million, and a total estimated population supported equivalent to almost 16,800 person years.

Table 33. Multi-Year Employment, Income and Population Total Effects (Alternatives C-D)

Cumulative Effects	Iron Point	Elk Creek	Combined
Total Employment Years	3,771	3,498	7,269
Multi-Year Payroll	$126,425,920	$116,737,150	$243,163,070
Total Person Years (population)	8,638	8,122	16,760

Source: E.D. Hovee & Company, based on Alternative C and D reasonably foreseeable scenario, August 1999.

3.5 Fiscal Effects for All Alternatives

Unlike the other socioeconomic effect sections of this report, only fiscal effects directly related to the mining activity on the two lease tracts are estimated. Estimating indirect, total, and cumulative fiscal effects is more problematic and not easily quantified. While some level of impact additional to the estimated direct effects would be generated, it is not anticipated to be of any substantial level compared to the direct effects.

Major revenue sources anticipated to be lost (No-Action Alternative) or generated (Action Alternatives B, C, and D) under each alternative include federal royalties, state severance tax, state and local sales tax, and property taxes

Each source is distributed to different jurisdictions (or taxing authorities) and has very specific allocation schedules as well as uses. Federal revenue and state regulations govern how each tax is calculated, distributed, and used. Primary sources include:

- **Federal Royalties** — calculated using the amount of coal extracted and the most current market value (or spot price) of coal. The tax rate established by the federal government for underground mined coal is 8%. One-half of the federal royalties are returned to the state that produced the coal. The state of Colorado has established a special mineral leasing fund. Twenty-five percent of this fund is allocated to state public schools, 50% to locally impacted jurisdictions, 10% to the Colorado water conservation board construction fund, and 15% to the local energy impact fund. Funds are designated to be used for planning, construction, and maintenance of public facilities or for public services.

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- **Federal Royalties** — calculated using the amount of coal extracted and the most current market value (or spot price) of coal. The tax rate established by the federal government for underground mined coal is 8%. One-half of the federal royalties are returned to the state that produced the coal. The state of Colorado has established a special mineral leasing fund. Twenty-five percent of this fund is allocated to state public schools, 50% to locally impacted jurisdictions, 10% to the Colorado water conservation board construction fund, and 15% to the local energy impact fund. Funds are designated to be used for planning, construction, and maintenance of public facilities or for public services.

- **Colorado State Severance Tax** — calculated using the annual amount of coal produced, after the first 32,000 tons.[32] The tax rate is $0.54 per ton, but the first 32,000 tons are exempt and a 50% credit is given to underground mines. Half of the tax funds collected are distributed to the Department of Natural Resources (for natural resource replacement or state water conservation) and the other half is allocated to the local severance tax fund. Eighty-five percent of funds allocated to the local severance tax is distributed to affected jurisdictions for planning, construction, and maintenance of public facilities or for public services. The other 15% is distributed to counties or municipalities based on mine workers place of residence and can be used for discretionary purposes.

- **Sales Taxes** — assessed on most non-essential household goods. Funds are deemed discretionary and can be spent on any need by state or local government. The state of Colorado rate is 3%. For this EIS, the city of Delta has a local sale tax rate of 3% which is also used because local expenditures by mine operators and a significant portion of household expenditures occur within the city of Delta.[33]

- **Property Taxes** — levied by taxing districts that have been established by local voters. Levy rates vary by district and are usually expressed in terms of per $1,000 of taxable assessed value. Delta County levies a rate of $18.082, Gunnison County $13.179, Delta County Joint School District #50 $32.520, Paonia Cemetery District $1.000, Colorado River Water District $0.309, North Fork Water District $0.612, Delta County Memorial Hospital $1.730, Delta County Library $2.924, and North Fork Pool and Recreation District $1.379. Facilities located in Delta County are assessed at a combined levy rate of $58.556, with assessment of $46.620 for facilities in Gunnison County. While these tax rates appear extraordinarily high, only 29% of the value of a property is assessed as prescribed under state law.

3.5.1 Fiscal Effects of Alternative A (No-Action Alternative)

The Bowie No. 2 and Oxbow mines would produce a total of 7.7 million tons of coal per year. Until mining ceases (3.7 million tons per year for Bowie No. 2 for 1.5 years and 4 million tons per year for Oxbow for about 4 years). Average market value of coal is assumed at $18.50, the average sales price in 1997. Current purchases for operations approximate $49 million with an assumption that 20% of purchases are made locally (primarily in the city of Delta).

A substantial amount of revenue that the state and local jurisdictions rely on to provide services likely would be lost if the two coal leases are not issued. It is estimated that annual revenues lost by federal royalties from the two lease tracts would be over $5.7 million, half of which would have been distributed between local jurisdictions in the two-county study area.

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[32] As of July 1, 2000, the first 8,000 tons per quarter are exempt. Currently, the exemption is the first 25,000 tons per quarter (CRS 39-29-106).

[33] Sales tax rates for individual jurisdiction was also presented in Section 2.0, Affected Environment, in this report.

An estimated $2.1 million in annual state severance tax would be lost, of which 50% would have been scheduled to be available to local jurisdictions. Also, an annual $1.8 million in sales tax would not be generated; almost $330,000 would have been distributed to local jurisdictions.

The substantial reduction in tax revenues could place a burden on local service providers. If the affected residents remain in the two-county study area, then providers that rely the most on mining tax revenues may need to make cuts in the services they provide, lower their level of services, or find alternative replacement funding .

Total reduction in annual revenue is estimated at $5.9 million for state government and $5.5 million to affected local governments, or $11.4 million in combined state and local government revenue. An estimated $1.7 million in reduced revenue could also occur as a result of reduced personal income

3.5.2 Fiscal Effects of Action Alternatives (B, C and D)

Taken together, mining production from the Iron Point and Elk Creek Coal Lease Tracts is projected to produce a combined 9.0 million tons of coal per year. Market value of coal is assumed at $18.50 per ton, the average sales price in 1997.

Capital expenditures for this mining are estimated at $31.0, with less than 6% being purchased locally. Current purchases for operations are assumed at $49 million with an assumption that 20% of purchases are made locally (primarily in the city of Delta).

Approximately 92% of mine employees are estimated to live within the local study area. Approximately 50% of the mining activity on the Elk Creek Tract would occur in Delta County; all other mining activity is allocated to Gunnison County. The entire Iron Point Coal Lease Tract is located in Gunnison County.

Annual revenues generated from coal production from the two lease tracts would result in almost $6.7 million of federal royalties, one-half of which would be distributed between local jurisdictions in the two-county study area.

An estimated $2.4 million in annual state severance tax also would be generated. Based on current allocations, 50% would be distributed to the local study area, with the majority of the 15% local distribution returning to the cities of Paonia and Hotchkiss.

An annual $1.8 million in sales tax would be generated by annual mine operation purchases, almost $330,000 being anticipated for the city of Delta. Anticipated capital expenditures for the mining activities are estimated to generate almost $1.0 million dollars in sales tax. Approximately $60,000 is projected to be captured by the city of Delta.

Construction workers are expected to continually generate $13,600 annually in property taxes. Mine operation workers are estimated to generate $136,700 annually, with an estimated $30,300 for reclamation employees.

Mining from the two lease tracts is anticipated to generate $807,400 to $866,800 in property taxes annually. The majority (75%) would be allocated to Delta County taxing districts, with the remainder going to Gunnison County districts. The Delta County Joint School District #50 would receive 55% of the property taxes generated in Delta County and almost 70% in Gunnison

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Table 34. Direct Fiscal Effects by Action Alternative During Operations

Revenue Sources	**Annual Effects** Alt. B	**Annual Effects** Alt. C-D	**Multi-Year Effects** Alt. B	**Multi-Year Effects** Alt. C-D
Construction Phase (one year only):				
Sources Related to Mine:				
Sales Tax from Capital Purchases				
- State Assessment	$930,000	$930,000	$930,000	$930,000
- Local Assessment	$59,900	$59,900	$59,900	$59,900
Sources Related to Construction Workers:				
State Income Tax	$43,100	$43,100	$43,100	$43,100
Sales Tax				
- State Assessment	$27,200	$27,200	$27,200	$27,200
- Local Assessment	$27,200	$27,200	$27,200	$27,200
Property Tax	$13,600	$13,600	$13,600	$13,600
Subtotal State & Local Revenues	$1,101,000	$1,101,000	$1,101,000	$1,101,000
Operations Phase (annually recurring):*				
Sources Related to Mine:				
Federal Royalties	$6,660,000	$6,660,000	$33,300,000	$45,880,000
Severance Tax	$2,421,400	$2,421,400	$12,141,400	$16,731,400
Sales Tax from Purchases				
- State Assessment	$1,470,000	$1,470,000	$7,542,000	$9,252,000
- Local Assessment	$328,500	$328,500	$1,698,300	$2,008,800
Property Tax	$807,400	$866,800	$4,133,000	$6,261,400
Sources Related to Mine Workers:				
State Income Tax	$1,139,400	$1,139,400	$5,757,100	$7,576,300
Sales Tax				
- State Assessment	$298,100	$298,100	$1,506,000	$1,982,000
- Local Assessment	$273,700	$273,700	$1,384,300	$1,812,000
Property Tax	$136,700	$136,700	$691,700	$905,500
Subtotal State & Local Revenues	$13,535,200	$13,594,600	$68,153,800	$92,409,400
Reclamation Phase (annually recurring):*				
Sources Related to Mine:				
Sales Tax from Purchases				
- State Assessment	—	—	—	—
- Local Assessment	—	—	—	—
Sources Related to Reclamation Workers:				
State Income Tax	$232,100	$232,100	$232,100	$232,100
Sales Tax				
- State Assessment	$60,700	$60,700	$101,600	$101,600
- Local Assessment	$60,700	$60,700	$101,600	$101,600
Property Tax	$30,300	$30,300	$50,800	$50,800
Subtotal State & Local Revenues	$383,800	$383,800	$486,100	$486,100
Total Multi-Year Revenues	—	—	$69,740,900	$93,996,500

* Note: Combined annual effects show maximum potential activity when operations at Iron Point and Elk Creek Tracts are underway at the same time. Multi-year effects are in addition to what can be expected with Alternative A.

Source: E.D. Hovee & Company, August, 1999.

remainder going to Gunnison County districts. The Delta County Joint School District #50 would receive 55% of the property taxes generated in Delta County and almost 70% in Gunnison County. Each County government would receive approximately 30% of property taxes generated within their jurisdictions.

Under any of the action alternatives, local service providers are not anticipated to be negatively effected. Revenues generated should ensure continuation of community and public services to a level at least commensurate with current levels of service.

Average annual revenues directly associated with Alternatives B, C, and D for state and local jurisdictions combined are estimated at $1.1 million during construction, $13.5 to $13.6 million during operations, and $383,800 for the period of reclamation. The local government share of total revenues received would be 9% during construction, 52% for operations, and 24% with reclamation.

Total multi-year revenues to state and local governments are estimated at close to $70 million with Alternative B and $94 million with Alternatives C-D. Multi-year revenues are 35% greater with Alternatives C and D than with Alternative B due to the longer duration of mining activity. The local government share of total revenues received is 51% with Alternative B and 53% with Alternatives C and D.

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